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NAVAL CIVIL ENGINEERING LABORATORY
Port Hueneme, California

Sponsored by
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CONCEPT DEFINITION OF THE NAVY ENVIRONMENTAL PROTECTION DATA BASE (NEPDB) SYSTEM

15 August 1972

An Investigation Conducted by

STANFORD RESEARCH INSTITUTE
Menlo Park, California 94025

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ABSTRACT

This concept definition of the Navy Environmental Protection Data Base (NEPDB) system This report analyzes ~~the~~ user requirements for environmental data and develops characterizations of data base components. Preliminary concepts for data base organization and indexing are discussed ~~extensively~~; and a number of required data files are identified. The functions that the system must perform are discussed and shown in flow charts and more detailed signal flow diagrams.

Major alternative system operations discussed are: centralized/ decentralized operations, manual/automatic operations, and index and storage media. Trade-off analyses of these alternatives are made and evaluated according to specific criteria. The results of these evaluations are then used to synthesize a set of final NEPDB system options. These options are discussed and the preferred option is recommended. Assumptions made during the course of this study are listed and recommended for further study. A phasing of the growth of the NEPDB system is discussed with subsequent recommendations.

Finally, a plan for the NEPDB Phase II effort is developed, estimates of initial system implementation costs are given, and manpower costs for initial system operation are provided.

PREFACE

The starting date for this research was April 26, 1972.

The study was performed in the Engineering Systems Division and the Information Sciences and Engineering Division of Stanford Research Institute under the supervision of Arthur C. Christman, Jr., Assistant Director, Systems Planning Department. The project leader was David N. Berg.

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The final draft report and presentation were given on June 23, 1972.

CONTENTS

CONTENTS (Continued)

CONTENTS (Continued)

CONTENTS (Concluded)

ILLUSTRATIONS

ILLUSTRATIONS (Concluded)

TABLES

TABLES (Concluded)

I SUMMARY AND CONCLUSIONS

A. Summary

The NEPDB conceptual design is based on the need for accumulation and organization of environmental data to aid the Navy in meeting its environmental protection responsibilities ordered in Presidential Executive Orders and Department of Defense and Navy Directives. Before the establishment of the NEPDB program, Naval environmental activities related to data and operations were characterized by decentralized data storage, nonstandardized formats and procedures, minimal index aids, passive response capability, and relatively noncoordinated interactions.

A significant portion of the conceptual design effort has been devoted to analyzing alternatives to the above characteristics in order to meet the design objective--to produce a conceptual design of the NEPDB system that will provide maximum utility to the users and that, within the available resources and technology, will be the most cost-effective.

Special emphasis has also been given to developing the user data requirements, characterization of the data needed by the NEPDB, design of data organizational procedures, definition of system functions, and subsystem and system alternatives. The alternatives studied in the trade-off analyses were centralization/decentralization of operational

components, manual/automatic operations, and alternative index and storage media. These alternatives were used to develop and evaluate candidate systems.

B. Conclusions

The result of these investigations and analyses is a set of four system options (see Table 1) that are based on the concepts of a central data base with limited decentralized data storage at Navy bases (Figure 1) and a basically manual system operation with retention of present limited computer capabilities and allowance for their eventual enhancement. It is also recommended that microfilm storage be used for archive records.

The difference between the first two options shown in Table 1 is the use of manually generated indices in Option 1 and the use of computer-generated indices in Option 2. In either case, indices provide for location of standards, pollution control authorities, Naval elements, facilities inventory, and data sets containing measured parameters.

Option 3 also includes a computer-generated indices capability and adds the use of microfilm working storage. The use of microfilm working data and documents is intended to reduce the time and effort required for system operation and improve system reliability.

Of these three options, Option 2 is recommended over Option 1 because of the desirability of using the computer to do the complicated and resource-demanding job of developing and maintaining indices to data

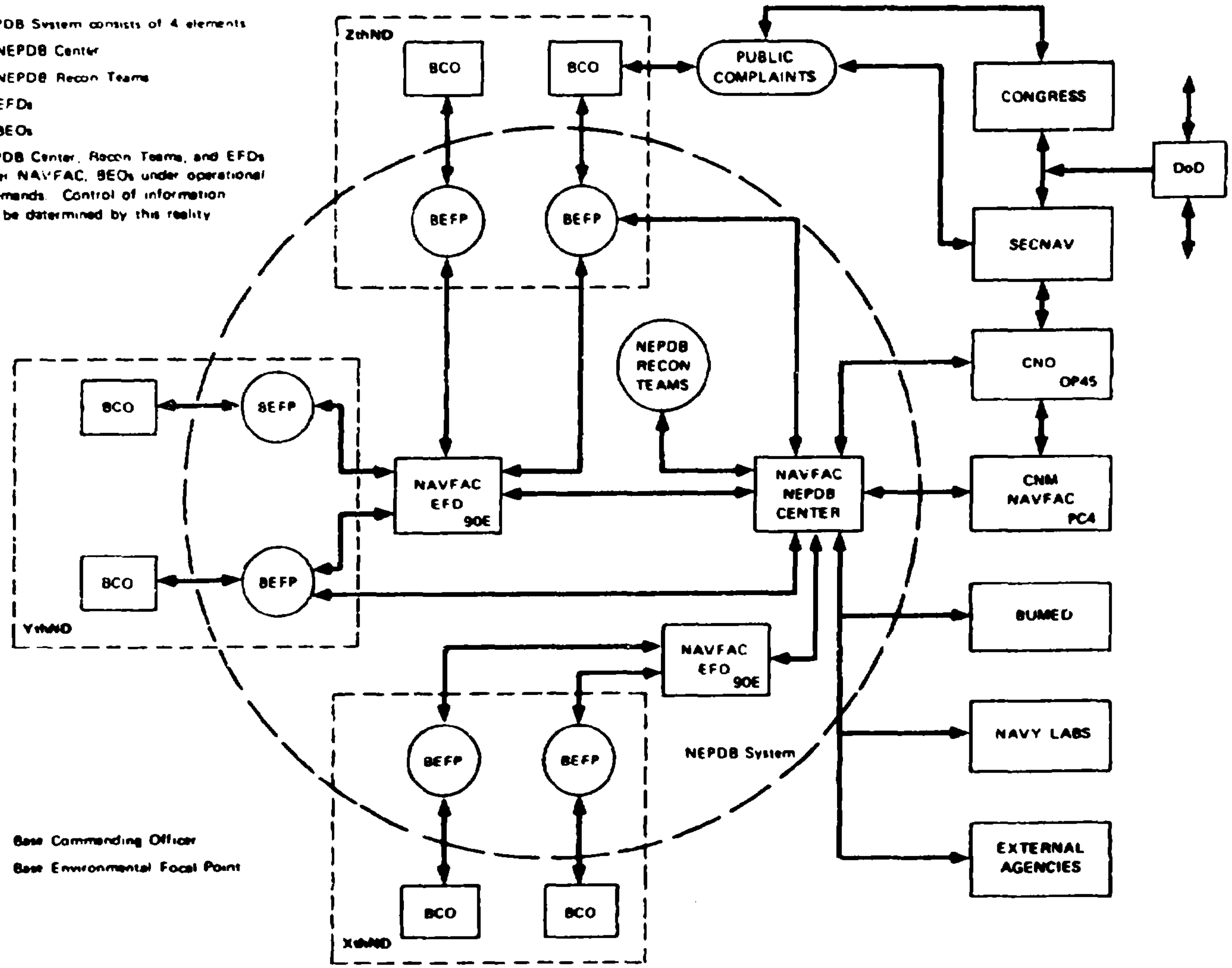
Table 1 SUMMARY OF FINAL OPTIONS OF INITIAL SYSTEM

Option	Data Location	Operations				
	Central Data Base with Navy Bases Storing Their Collected Data	Manual Processing in General; Limited Computer Capabilities at NCEL	Manually Generated Indices*	Computer Generated Indices*	Microfilm Working Storage	Microfilm Archive Storage
1	X	X	X			X
2	X	X		X		X
3	X	X		X	X	X
† 4	† For initial phase only, with procedures to transfer to Central Data Base after security features are proven	X		X		X

* Indices provide locations of standards, pollution control authorities, Naval elements, facilities inventory, data sets containing measured parameters, and so on.

1 NEPDB System consists of 4 elements
- NEPDB Center
- NEPDB Recon Teams
- EFDs
- BEOs

2 NEPDB Center, Recon Teams, and EFDs under NAVFAC. BEOs under operational commands. Control of information will be determined by this reality



BCO Base Commanding Officer
BEFP Base Environmental Focal Point

FIGURE 1 RECOMMENDED SYSTEM CONFIGURATION

files and data sets. Additionally, the use of a computer for index generation avoids the errors that occur in manual index generation and maintenance.

Option 2 is recommended over Option 3 because of the reluctance of personnel to use microfilm and the traditional inclination of personnel to demand a hard copy of data and documents with which they have to work. The uncertainty of overcoming these drawbacks has led to this recommendation; however, the use of microfilm working storage in the subsequent growth of the NEPDB System is contemplated.

Option 4 differs from Option 2 in that it specifies that the decentralized data storage at the Navy bases be moved to the Central Data Base after the security of data dissemination procedurer is proved to Navy base personnel who are responsible for the control of the collected data. This option does not constitute the prime recommendation because the assumption of data control sensitivity at the Navy bases must be studied further to determine the extent of the sensitivity and the security procedures that would be satisfactory to the personnel involved. Even if the sensitivity question is resolved, a cost/benefit problem remains to be evaluated. The magnitude of the environmental monitoring effort within the Navy may cause centralized storage of environmental parameter values to be economically and procedurally infeasible. It is thus also necessary to validate assumptions regarding data volumes before any definitive choice between Options 2 and 4 can be made.

SRI recommends Option 2 as the most promising and desirable NEPDB system design, with the provision that the other options be reconsidered if the result of further study and validation of the assumptions made during the course of this contract indicates that the other options might become more competitive with Option 2.

A comparison* of the Navy's previous procedures for handling environmental data and identifying environmental problems affecting the Navy with the recommended NEPDB system has shown that the recommended system design provides significant improvements in the Navy's capability to compile and organize data in a way that allows information on (1) environmental standards, (2) measured data, and (3) problem-solving experience and technology to be readily accessed, analyzed, and disseminated in a systematic, coordinated manner. In addition to these vastly improved organizational advantages, the recommended system provides procedures by which the Navy can avoid some unfortunate and embarrassing incidents through its deficiency assessment and reporting capabilities.

*See Section XIV, Subsection B.

II INTRODUCTION

Since the passage of the Federal Water Pollution[1] and the Solid Waste Disposal Acts[2] in 1965, the Federal Government has taken an increasingly active role in environmental matters. In 1969 the National Environmental Policy Act created the Council on Environmental Quality,[3] an agency fixed with the responsibility for establishing guidelines for control of the impact of departments and agencies of the Federal Government on the environment. As part of its function and in response to Presidential Executive Order 11514,[4] the Council on Environmental Quality issued a set of guidelines for all federal agencies dealing with the preparation of environmental impact statements for activities of these agencies.[5] In 1970 the Environmental Protection Agency was established as a centralized regulatory and enforcement agency for matters dealing with air and water pollution, solid waste management, pesticide regulation, environmental radiation, and noise. The powers

[1] 33 United States Code 466 (et seq.).

[2] Solid Waste Disposal Act (as amended), Public Laws 89-272 and 91-512.

[3] Public Law 91-190.

[4] The Whitehouse, Washington, D.C., March 4, 1970.

[5] "Guidelines for Federal Agencies Under the National Environmental Policy Act," Council on Environmental Quality, Washington, D.C. (April 23, 1970).

of the Environmental Protection Agency were further strengthened in 1970 and 1971 with the passage of the Clean Air Act[6] and the strengthening of its water pollution central authority.

This increase in importance attached to environment has not been limited to the nonmilitary organizations mentioned above. The U.S. Navy has long recognized the unique environmental problems that it creates, both from the standpoint of Naval operating facilities within the United States and its possessions and from the standpoint of fleet operations. The Navy has had a continuing problem with such matters as the control of oil spills, the discharge of untreated oil and solvents from ships and facilities, shipboard waste treatment, control of sewage and air pollutant emissions from shore installations, and the noise occurring from aircraft in the normal execution of their mission.

The U.S. Navy has chosen to pursue a vigorous plan of action to determine its effect on the environment and to establish abatement plans and actions. The U.S. Navy has elected to initiate the development of an environmental protection data base to support Navy adherence to environmental standards; reduction of operations producing adverse effects on the environment; and cooperation with existing local, regional, and national environmental protection agencies.

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[6] Clean Air Act (as amended), 42 United States Code 1857, Public Laws 90-148 and 81-604.

It is noteworthy that the U.S. Navy is establishing a program that will set an example for the other military services in the development of an environmental protection data base.

III OBJECTIVE

The objective of this study is to develop a conceptual design of the NEPDB system that will provide maximum utility to the users and that, within the available resources and technology, will be the most cost-effective. The design must have sufficient flexibility to allow ease of modification and the growth capability that will be required as the environmental technologies advance and the state of the art of environmental parameters measurement becomes better understood and defined.

The system to be defined is intended to support Naval requirements for adherence to emission standards and to aid Naval planning in environmental protection. This conceptual design proposes to meet the objectives by defining a system that unifies the data collection/storage and deficiency assessment actions that are currently being made in an ad hoc, decentralized, and independent manner.

IV BASIC CONSTRAINTS AND ASSUMPTIONS

It is important to identify the factors that imposed major constraints on the conceptual design and the major assumptions that affected the design effort from beginning to end.

A. Constraints

The major constraints on the conceptual design were:

(1) The initial NEPDB system must be operational by 1 July 1973. This constraint results from a series of schedule data requirements and has a significant effect on the design of the initial system. However, modification of the system after the initial stage is not precluded.

(2) The NEPDB system must fit within the existing Navy framework. This constraint bounds the NEPDB functions and system employment within the Navy organizational and operational limits.

(3) NEPDB dissemination of data and information is subject to the control of authorized Navy sources. The sensitivity of some data collected at Navy bases and other installations requires that authorization be obtained before release of data outside the Navy and even between Navy elements.

(4) The conceptual design does not include the setting of data collection requirements, but the study team should identify data deficiencies. The scope of the conceptual design was limited from the outset by a careful delineation of the areas to be analyzed; however, the design effort was aided by the identification of deficiencies and potential problems in the data measurement and collection operations.

B. Assumptions

The major assumptions used by the study team were:

(1) The main purpose of the data base system is to provide information to aid the Navy in addressing its environmental problems. The NEPDB system identifies needs for correction of deficiencies but is itself not a Navy decision-making element.

(2) The NEPDB will be developed in phases to ensure orderly growth. Since the environmental technology has not reached its full potential in some areas and is just beginning in other areas, the NEPDB must maintain orderly growth that satisfies changes in technology and also in priorities. The maintenance of growth capabilities in an orderly fashion is ensured by careful planning of development phases and transitional procedures within the phases.

(3) The NEPDB system will have access to all Navy measurements and standards data pertaining to the environment, as well as to other government-sponsored data bases. These data and data bases will not necessarily be located physically in a NEPDB facility, but assurance that data will be available from sources external to the NEPDB system is required to develop a complete data base within the Navy resource constraints.

V METHOD OF APPROACH

SRI employed a systems approach to develop the NEPDB conceptual design. This entailed an analysis of the total NEPDB system operation to ensure that all the functions and their interrelationships were specified in sufficient detail to provide a balance between the design of the system response to the user's demands and the development of the most cost-effective system possible.

The conceptual design was divided into three phases:

(1) Requirements identification

(2) Design

(3) Evaluation and selection.

Because various Navy organizations were involved in activities that affected the environment and existing Naval agencies were established to coordinate environmental protection efforts, analyses of the Navy's organizational relationships in the environmental area were made. Existing Navy environmental directives were analyzed in detail to determine the Navy's responsibilities for environmental protection. Aspects of the Navy's organization, combined with the Navy environmental responsibilities, determined requirements for action and established needs for information on which these actions would be based. The information so determined formed a foundation for data requirements for the data base.

The next step was to characterize the data components by identifying Navy facilities that emitted pollution and then to determine categories of data for these facilities. Specific environmental data sources contributing to such data categories and estimates of the amount of such data were derived.

The design phase developed the system functions required to respond to user requests, assess deficiencies of meeting standards at Navy activities, and act as a source of information for planning and abatement. Investigations of alternative data base organizations were conducted and various indexing mechanisms were postulated. Alternatives were developed for (1) centralization/decentralization of operations, (2) manual/automatic function performance, and (3) index and storage media.

The evaluation and selection phase first established evaluation criteria, postulated trade-offs among the alternatives developed in the design phase, determined candidate systems, and then evaluated these candidates by application of the evaluation criteria. Three final system options were finally synthesized, each of which were satisfactory system structures, and one system was specified as the preferred option as a result of the evaluation procedure.

A plan for the Phase 2 Preliminary Detailed Design was then developed and documented.

VI REQUIREMENTS IDENTIFICATION

A. Navy Organizational Aspects of Environmental Protection

This topic was addressed first in the Requirements Identification Phase of this project because the NEPDB system's success will depend to a large extent on the specific design approach used to provide system responses to Navy environmental problems that come from diverse points--geographically, organizationally, and functionally--in the Navy. This impels the design to account for Navy operating procedures, formal and informal, as they relate to Navy environmental responsibilities.

The development of information flow within the NEPDB system is also dependent on the provision for proper incorporation of the needs of the Navy's environm tal coordinating offices and focal points in the system design, e.g., PO-45, PC-4, and Code 90E.

The position of the Navy EPDB Program in the Navy organization together with the major potential data base user organization blocks, is shown in Figure 2. This figure shows grossly how the data base program fits in the Navy operations, without considering the environment focal points. Figure 3 shows a more detailed breakdown from the Department of Defense level down to the NEPDB Program, a fairly complete organizational layout of the expected data base users, and the environmental coordination and focal point activities as they fit into the Navy chains

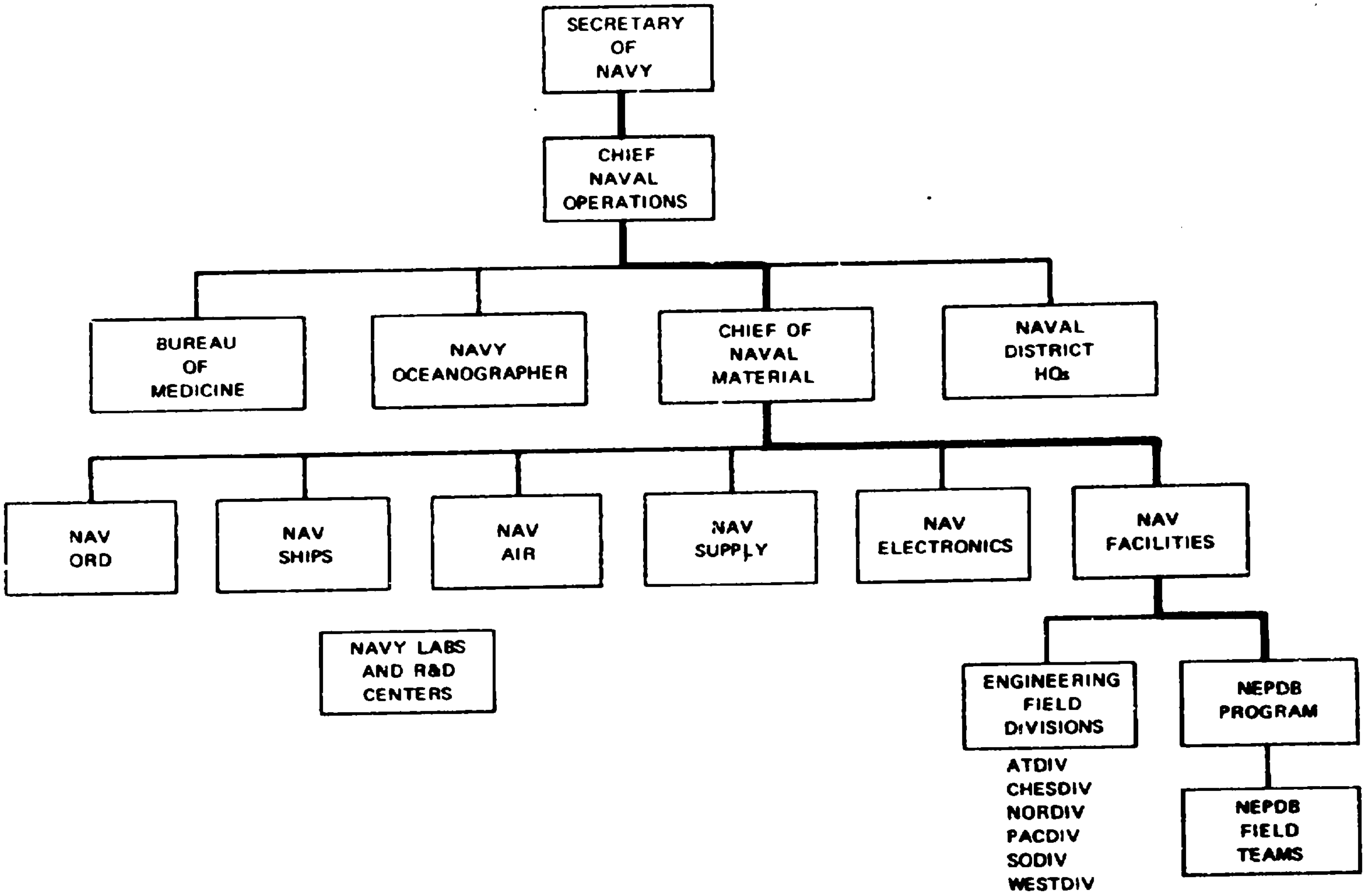


FIGURE 2 NAVY EPDB PROGRAM RESPONSIBILITY CHAIN AND MAJOR POTENTIAL DATA BASE USERS

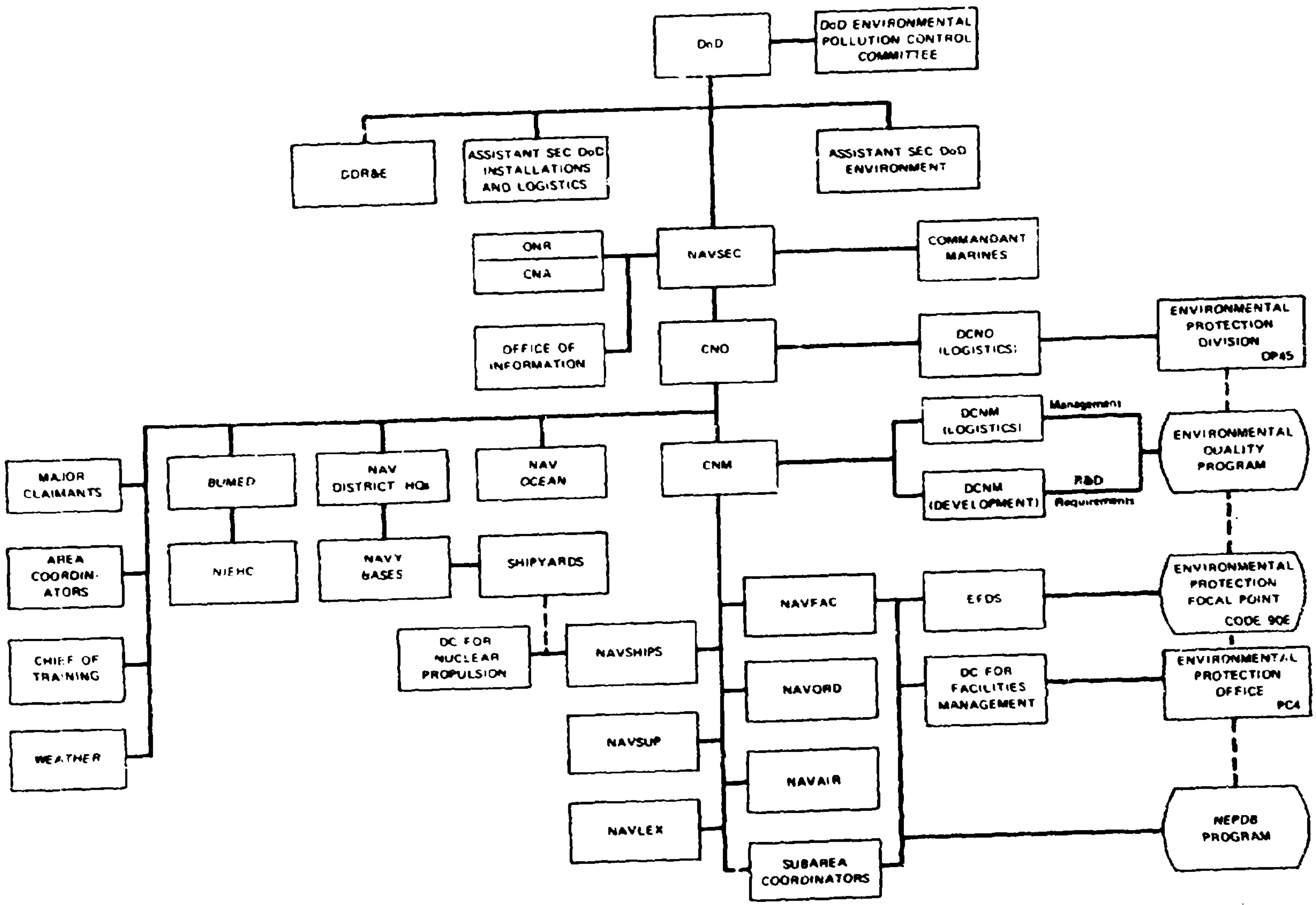


FIGURE 3 INFORMATION REQUIREMENTS FLOW FOR NEPDB DATA

of command. This figure shows also some of the possible chains of responsibility for environmental protection that make the determination of possible NEPDB users difficult. For example, in the middle of Figure 3 the shipyards are shown to be connected to Navy bases in one direction and connected to NAVSHIPS in another. This points out that the responsibility for an environmental problem at a shipyard may go to the Navy base Commanding Officer, who reports to a Naval District and Naval District HQS under CNO, or may go to NAVSHIPS, who report to CNM under CNO. Thus, the funding to provide abatement for this environmental problem may lie in two (or more) separate organizations. To rectify the problem itself, the Navy base Commanding Officer or the Public Works Officer may approach for assistance the Enginnering Field Division having jurisdiction over that shipyard and Navy base. As far as the NEPDB program is concerned, questions as to standards, costs of abatement, previous Navy experience in similar problems and abatement, and environmental technology can be broached to the data base from any of these organizations.

Further complexities of possible questions and sources of questions occur because of overlapping responsibilities. For example, the responsibilities of area coordinators and subarea corrdinators for local Navy bases falling in their jurisdictions overlap with those of Navy base Commanding Officers.

The organization shown in Figure 3 can be described somewhat differently by breaking out levels of users. Table 2 shows six levels of

Table 2

LIST OF POTENTIAL NEPDB USERS

High Level, Department of Defense
DoD Environmental Pollution Control Committee
DDR&E
Assistant Secretary DoD for Environment
Assistant Secretary DoD for Installations and Logistics
First Level, Department of Navy
Secretary of Navy
Commandant of Marines
Chief of Information (Office of Information under SECNAV)
Media Relations (Office of Information under SECNAV)
Committee Relations (Office of Information under SECNAV)
Office of Legislative Affairs (under SECNAV)
Second Level, Department of Navy
CNO
DCNO (Logistics)
Environmental Protection Division (OP-45)
Third Level, Department of Navy
CNM
DCNM for Logistics
DCNM for Development
Environmental Quality Program
BUMED
NAVOCEAN
Naval District HQs
Chief of Training
Chief of Weather
Area Coordinators
Fourth Level, Department of Navy
NAVFAC
DC for Facilities Management (NAVFAC)
NAVSHIPS
DC for Nuclear Propulsion (NAVSHIPS)
NAVSUP
NAVLEX
NAVAIR
Environmental Protection Office (PC-4)
NIEHC (under BUMED)
Navy Base Commanders
Fifth Level, Department of Navy
EFDs
Commanders of Shipyards
Subarea Coordinators

users--one for DoD and five for the Navy. The first three levels are likely to direct their inquiries to the data base through OP-45. At the present time most questions at these three top levels are addressed to OP-45, which seeks answers from PC-4, EFDs, and so on.

When the NEPDB system is in operation, it is expected that the third and fourth level of users will address many questions to the data base through the EFDs for the most part, whereas, at the present time, their questions go mainly to OP-45, the EFDs, and the Navy bases.

The fifth level of users is now left mostly to their own level for resources, and it is intended that the data base will relieve their loads significantly in the environmental area, in addition to providing more information in a shorter amount of time.

The result of these analyses and the analyses of the Navy directives (to be discussed in the next section) is presented in Figure 4. Here the primary users and their main method of access are shown. It is interesting to note that the EFDs are likely to be the prime users of the data base, with Navy environmental coordinating agencies, e.g., OP-45, the next heaviest users, although the initial questions asked may have originated from high Navy or DoD levels.

B. Directives Analysis

Table 3 shows the directives that were examined to derive specific requirements and responsibilities for the various steps of environmental protection. Examples of required tasks, executing authorities, and

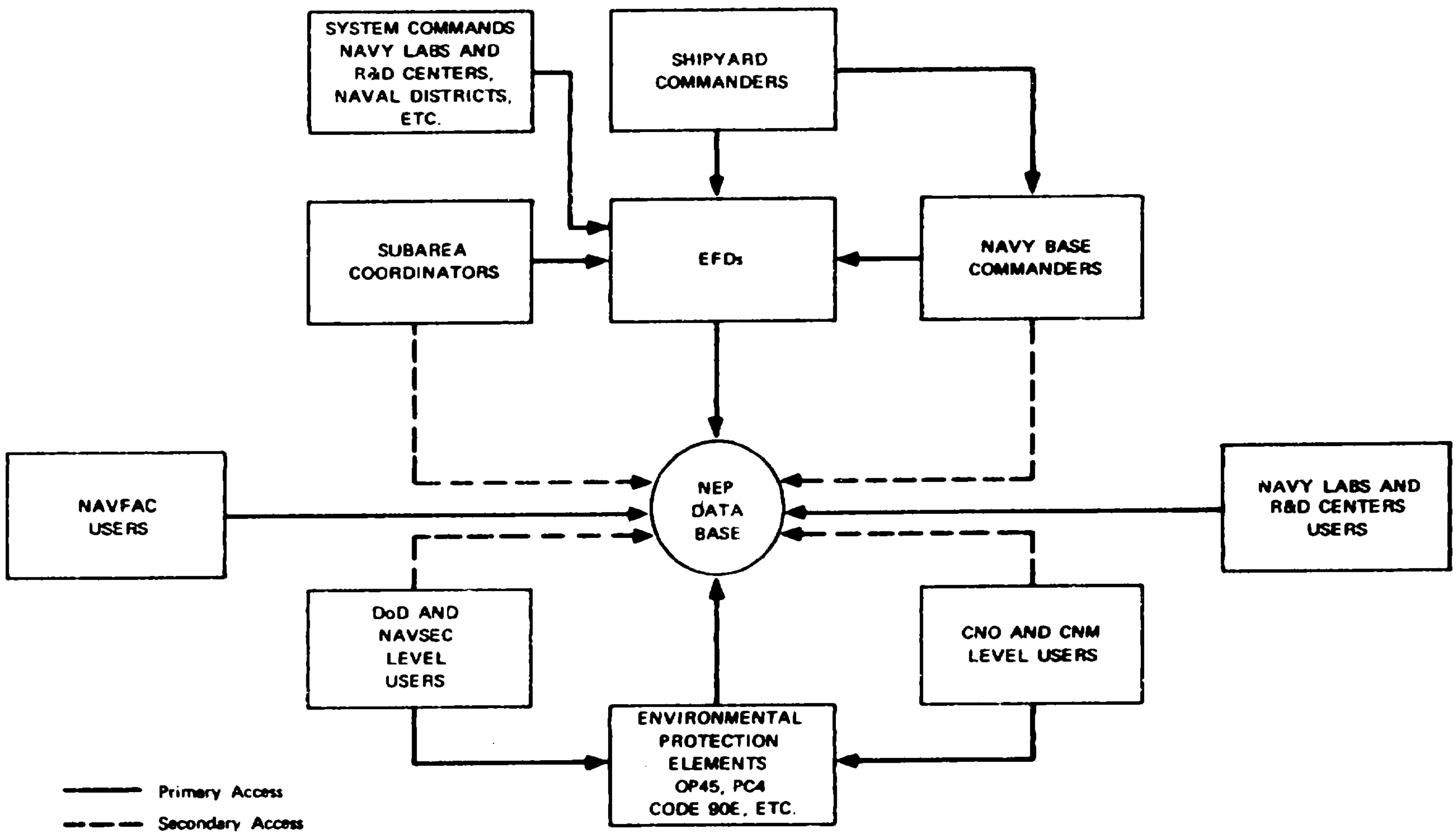


FIGURE 4 CONCLUSIONS ON MAJOR NEPDB USERS

Table 3

DIRECTIVES ANALYZED

Originating Organization	Number	Date
Executive Order	11507	4/02/70
	11514	5/03/70
DoD INST	4120.14	14/05/71
DoD DIR	5100.50	23/06/70
SECNAVINST	5305.1	22/07/71
	5430.54A	7/01/70
	6240.6B	2/11/70
OPNAVINST	6240.1A	4/04/69
	6240.2A	11/12/70
	6240.3A	14/09/71
	6240.4	2/03/71
	6240.5	28/08/71
	9330.5A	30/08/65
OPNAVNOTE	6240	11/11/71
NAVMATINST	5100.3	17/07/69
	6240.1A	18/08/71
	6240.2	27/01/71
	6240.3	25/02/71
NAVMATNOTE	6240	12/11/70
BUMEDINST	6240.3B	30/09/63
	6260.6B	5/03/70
NAVAIRINST	6240.1	10/04/70
NAVFACINST	6240.1	29/08/66
	6250.12	1/04/70
	6250.3C	20/06/69
	6250.5A	11/02/69
	11012.126	20/03/72
NAVSUPINST	6240.1	27/04/71
OCEANAVINST	3161.1	20/10/66

Table 4
TASKS SPECIFIED BY DIRECTIVES

Tasks	Executing Authority	Directives
Implement Navy policy on protection of the environment	DCNO (Logistics) EPD (OP-45)	OPNAVINST 6240.2B 10 November, 1971
Advise commands in special cases of the necessity for submitting written assessments and/or candidate impact statements	DCNO (Logistics) EPD (OP-45)	OPNAVINST 6240.2B 10 November, 1971
Comply with the Congressional mandates for protecting the environment	All Navy	OPNAVINST 6240.2B 10 November, 1971
Be aware of actions considered significant and exceptions when engaged in activities or combinations of activities that affect the environment	All Navy	OPNAVINST 6240.2B 10 November, 1971
Monitor, evaluate, and control on a continuing basis all activities to protect and enhance the quality of the environment	Heads of all federal agencies	Executive Order 11514 5 March, 1970
Develop programs to protect and enhance environmental quality and assess progress in meeting the specific objectives of such activities	Heads of all federal agencies	Executive Order 11514 5 March, 1970
Consult with appropriate federal, state, and local agencies in carrying out activities that affect the quality of the environment	Heads of all federal agencies	Executive Order 11514 5 March, 1970
Develop procedures to ensure the fullest practicable provision of timely public information and understanding of Federal plans and programs with environmental impact	Heads of all federal agencies	Executive Order 11514 5 March, 1970
Ensure that information on existing or potential environmental problems and control methods...is made available to federal, state, and local agencies and other entities as appropriate	Heads of all federal agencies	Executive Order 11514 5 March, 1970
Review statutory authority, regulations, policies, and procedures which prohibit or limit full compliance with their responsibilities	Heads of all federal agencies	Executive Order 11514 5 March, 1970
Exchange data and research results and cooperate with agencies of other governments	Heads of all federal agencies	Executive Order 11514 5 March, 1970

Table 4 (Continued)

Tasks	Executing Authority	Directives
Maintain review and surveillance to ensure that Federal air and water quality standards (or other applicable standards) are met on a continuing basis	Heads of all federal agencies	Executive Order 11507 4 February, 1970
Identify potential air and water quality problems associated with the use and production of new materials and make provisions for their prevention and control	Heads of all federal agencies	Executive Order 11507 4 February, 1970
Consult with agencies' secretary about best techniques and methods available for the protection and enhancement of air and water quality	Heads of all federal agencies	Executive Order 11507 4 February, 1970
Develop and publish procedures to ensure that facilities under their jurisdiction are designed, operated, and maintained so as to meet applicable air and water quality standards	Heads of all federal agencies	Executive Order 11507 4 February, 1970
Provide leadership in prevention, control, and abatement of air and water pollution at federal facilities	Heads of all federal agencies	Executive Order 11507 4 February, 1970
Action shall be taken to avoid or minimize wastes created through the complete cycle of operations of each facility	Heads of all federal agencies	Executiv[illegible] 11507 4 Febr[illegible]
The use of municipal or regional waste collection or disposal systems shall be the preferred method of disposal of wastes from Federal facilities	Heads of all federal agencies	Executive [illegible] 4 February, [illegible]
Installation and operation of waste treatment and disposal facilities where municipal or regional facilities are not available	Heads of all federal agencies	Executive Order 11507 4 February, 1970
Provision of trained manpower, laboratory, and other supporting facilities as appropriate to meet requirements	Heads of all federal agencies	Executive Order 11507 4 February, 1970
Establishment of requirements that operators of pollution control facilities meet levels of proficiency consistent with operator certification requirements of the state in which the facility is located	Heads of all federal agencies	Executive Order 11507 4 February, 1970

Table 4 (Continued)

Tasks	Executing Authority	Directives
The use, storage, and handling of all materials shall be carried out to avoid or minimize the possibilities for water and air pollution	Heads of all federal agencies	Executive Order 11507 4 February, 1970
No waste shall be disposed of or discharged in such a manner that could result in the pollution of ground water that would endanger the health or welfare of the public	Heads of all federal agencies	Executive Order 11507 4 February, 1970
Discharges of radioactivity shall be in accordance with the applicable rules, regulations, or requirements of the AEC and the policies and guidance of the Federal Radiation Council	Heads of all federal agencies	Executive Order 11507 4 February, 1970
Ensure effective coordination with other elements of the Office of the Secretary of Defense and with nonmilitary agencies concerned with environmental quality matters	Asst. Sec. Defense (H & E)	SECNAVINST 6240.6B 2 November, 1970
Identifying and evaluating on a continuing basis activities and conditions affecting environmental quality	Asst. Sec. Defense (H & E)	SECNAVINST 6240.6B 2 November, 1970
Ensure that environmental quality problems associated with the use and productions of new materials are recognized and that provisions are made for their abatement and control	Asst. Sec. Defense (H & E)	SECNAVINST 6240.6B 2 November, 1970
Implement pertinent Executive Branch guidance on environmental programs	Asst. Sec. Defense (H & E)	SECNAVINST 6240.6B 2 November 1970
Provide advice on the probable environmental consequences of major activies of DoD components affecting the quality of the environment	Asst. Sec. Defense (H & E)	SECNAVINST 6240.6B 2 November, 1970
Programming, planning, design criteria, and technical review of real property facilities for the prevention or correction of environmental pollution	Asst. Sec. Defense, (Installations & Logistics)	SECNAVINST 6240.6B 2 November, 1970
Maintenance, operation, and repair of real property facilities for the prevention or correction of environmental pollution	Asst. Sec. Defense, (Installations & Logistics)	SECNAVINST 6240.6B 2 November, 1970

Table 4 (Concluded)

Tasks	Executing Authority	Directives
Establish environmental values for military construction, including architecture and aesthetics of buildings and installations	Asst. Sec. Defense, (Installations & Logistics)	SECNAVINST 6240.6B 2 November, 1970
Ensure development and management of an effective land management and natural resource conservation program at all military installations	Asst. Sec. Defense, (Installations & Logistics)	SECNAVINST 6240.6B 2 November, 1970
Assist in the prevention of environmental pollution by contributing to and coordinating in the publication of procedures for pollution control in conformity with the applicable standards	Asst. Sec. Defense, (Installations & Logistics)	SECNAVINST 6240.6B 2 November, 1970
Perform such research as necessary to define and study environmental pollution problems associated with military requirements	DDR&E	SECNAVINST 6240.6B 2 November, 1970
Arrange for the prompt transmission to the appropriate federal agency of results of defense research on toxic hazards and environmental pollution	DDR&E	SECNAVINST 6240.6B 2 November, 1970
Coordinating research conducted by the DoD with other federal agencies	DDR&E	SECNAVINST 6240.6B 2 November, 1970
Ensure that consideration is given to the control of environmental pollution in research, development, test, and evaluation projects and programs	DDR&E	SECNAVINST 6240.6B 2 November, 1970
Identify environmental quality problems and take corrective measures in accordance with policy guidance and general standards	SECNAV	SECNAVINST 6240.6B 2 November, 1970
Make provisions in programming budget estimates and financing programs for environmental quality consistent with directives	SECNAV	SECNAVINST 6240.6B 2 November, 1970
Institute necessary measures to monitor environmental quality control methods to ensure that these methods maintain the required general standards of quality	SECNAV	SECNAVINST 6240.6B 2 November, 1970

Table 5
REQUIREMENT SUMMARY

Identify and control environmental quality problems
1. Identify sources, parameters
2. Identify problems
3. Initiate procedures for abatement
4. Conform to standards
5. Correct existing operations
Monitor environmental quality control methods
6. Monitor air, water, solid waste, oily waste, noise pollution
7. Monitor pesticide usage
Plan and budget environmental quality programs
8. Review existing operations
9. Review all construction plans
10. Prepare environmental impact statements
11. Establish requirements
12. Submit plans (with costs) for prevention, control, abatement, monitoring
Coordinate with other agencies
13. Make information about current and planned programs available to other federal and local agencies
14. Exchange research results with other federal and local agencies

directive identification are given in Table 4. Analysis of these tasks led to the identification of requirements shown in Table 5.

Each requirement has been broken down further in Table 6 to determine its implications. Location of responsibility for satisfying each requirement is shown in Table 7. It should be noted in this table that NAVFAC EFDs are the organizations most heavily tasked by these requirements.

From the analysis of the directives, five specific Navy duties for environmental protection were derived, questions that arrive from examination are posed, and implications are determined (Table 8).

Details of these analyses are given in Appendix A.

C. User Survey

To satisfy user requirements, certain questions must be asked and certain data must be available. Preliminary prime questions are outlined in Table 9 as a result of the above analyses stemming from the 14 requirements tasks that were identified.

To learn more of the background of the questions and the operational context in which an environmental data base system will have to operate, SRI staff members made field trips to facilities and telephone calls to potential data base users. These contacts are summarized here:

Contactee	Contact Type
EFD, San Bruno	Phone calls, visit
Mare Island Naval Shipyard	Visit
Alameda Naval Air Station	Visit
OP-45	Phone calls
PC-4	Phone calls

Table 6

BREAKDOWN OF REQUIREMENTS

Requirement	Implications
1. **Identify sources, parameters** Monitor discharges and emissions Analyze data	Monitoring equipment and personnel available Data are available for analysis
2. **Identify problems** Monitor discharges and emissions Analyze data and compare with criteria Predict future occurrences and levels	Monitoring equipment and personnel available Data are available for analysis Standards and criteria are available Models are available to analyze and predict
3. Initiate procedures for abatement Identify the pollution problem Has a similar problem been solved? If answer is Yes, What procedures were used; equipment; cost How effective was the program Implement program, monitor and store results If answer is No, What general procedures are available Develop procedures, implement, monitor and store results	The pollution problem can be identified and characterized Abatement procedures are available
4. **Conform to standards** What is the geographical location? What are the applicable standards? Local State Federal Navy generated Does the Navy conform to the standards? If answer is No, Which parameters do not conform? By how much are the standards violated? Can correctional measures be taken immediately? What are the long-term correctional measures?	The standards are known and available Sufficient reliable data are available to compare to the standards Analysis and prediction capabilities are available to assess deficiency Economic constraints are known Abatement procedures and equipment are available
5. Correct existing operations What operations are emitting or discharging pollutants? Compare with standards, criteria, and other similar operations Initiate correction programs	Same as implications under item 3

Table 6 (Concluded)

Requirement	Implication
6. Monitor oil, water, noise, solid waste, oily waste pollution Data required on Facilities and appropriate sources defined Monitoring procedures and equipment Reporting procedures Analysis procedures Storage procedures	Considerable interaction needed with the system
7. Monitor pesticide usage Inventory of incoming pesticides Process incoming requests for pest control Provide information on pest control Inventory of outgoing pesticides Catalog of pertinent research Conduct research	Pesticide distribution must be monitored Information must be available on new products and hazards of available pesticides File of continuing research must be maintained
8. Review existing operations What operations are emitting or discharging pollutants? Compare with standards, criteria, and other similar operations Initiate correction programs	Same as implications under item 3
9. Review all construction plans Probably not applicable to data base system	
10. Prepare environmental impact statement Identify the location and sources Identify the ecological makeup Retrieve information about the environmental effects Retrieve similar impact statements	Pollution sources are identifiable Composition of the ecological system is known Effect on each component is known Previous impact statements are available
11. Establish requirements	Probably a result of a good reporting system. Doubtful if any direct use of the system is required.
12. Submit plan for prevention, control, abatement, monitoring	This results in same questions and implications under item 3
13. Make information about current and planned programs available to other federal and local agencies Publish and distribute information to interested authorized recipients	Information is made available Authorized recipient list is maintained
14. Exchange research results with other federal and local agencies Perform research Report results Disseminate results	Interested recipient list is maintained

Table 7

RESPONSIBILITY FOR SATISFYING REQUIREMENTS

	Requirements 1	2	3	4	5	6	7	8	9	10	11	12	13	14
DoD				X									X	
DoD EPCC				X									X	
DDR&E				X									X	X
Asst. Sec. Logistics				X									X	
Asst. Sec. Environment				X									X	X
ONR/CNA				X									X	X
NAVSEC				X									X	
Commandant Marines				X									X	
Chief of Information				X									X	
CNO				X									X	
DCNO (Logistics)				X									X	
OP-45 EPD		X		X				X					X	X
Chief of Training				X									X	
BUMED				X			X						X	X
NAV District Hqs				X	X								X	
NAV OCEAN				X		X							X	X
CNM				X									X	
DCNM Logistics				X									X	
DCNM Development				X									X	
EQP				X									X	
Weather				X									X	X
NIEHC		X		X									X	X
Navy Bases		X	X	X	X	X				X		X	X	
Shipyards		X	X	X	X	X				X		X	X	
NAVFAC			X	X		X	X	X					X	X
EFDs	X	X	X	X	X	X	X	X	X	X	X	X	X	X
(Code 90E)			X	X									X	X
DC Nuclear Prop.			X	X									X	
NAVSHIPS			X	X									X	X
NAVSUP			X	X									X	X
NAVLEX			X	X									X	X
NAVORD			X	X									X	X
NAVAIR			X	X									X	X
DC for Facil. Manag.			X	X				X					X	X
Envir. Prot. Of PC-4		X		X				X				X	X	X
NEPDB Program	X			X		X	X			X			X	X

Table 8

ANALYSIS OF SPECIFIC DERIVED DUTIES

Duty	Implications
Minimize waste, air, and water pollution Specify a particular facility What is the current discharge by waste type? What procedures and/or equipment are available to reduce a particular type? What is the cost of implementation? What benefits will be derived?	Facilities and their discharges are known and retrievable Abatement procedures and equipment are available Historical cost data and design criteria can be obtained Historical and analytical beneficial data are available
Use existing municipal or regional facilities What is geographical location? What facilities are available? What are the Navy's needs now--quantity/quality? What are future Navy needs? What is suggested economic remuneration for services rendered by community?	Municipal facilities inventory for each Navy facility Quantity and quality of Navy discharge are known Historical and analytical cost data on treatment and disposal of waste must be known Growth potential of Navy facilities is known or estimated Emergency procedures are available
Minimize air and water pollution What is the geographical location? What are the general sources of pollution? What are the particular parameters and how much is emitted? What is the potential hazard? Economic Recreational Aesthetic What standards or criteria are available as a measure of this parameter's nuisance? What abatement procedures and equipment are available and what is the cost of implementation? How much abatement do we derive from x dollars? What research is currently being conducted? What projects or programs does the Navy have now; plan to have? What legislation is being planned that would affect Navy operations?	Pollution sources and their constituents are known quantitatively and qualitatively Information about the environmental impact of each parameter is available Standards and criteria are available Abatement procedures and equipment are known Economic constraints and values are available Effectiveness of various abatement procedures is categorized Catalog of research is maintained Catalog of Navy contracts is maintained Catalog of legislation is maintained
No ground water pollution What is the location? What ground water sources exist? What Navy processes contribute to ground water pollution? What are the alternatives? What is the cost of adopting the alternatives?	Ground water sources are known Relationships between Navy processes and ground water pollution are established Abatement procedures and cost are available

Table 9

USER QUESTIONS ON AUTHORITY, JURISDICTION, CONTROL, AND ENFORCEMENT

What environmental protection and/or pollution authorities have jurisdiction over a specific Naval installation or activity?

By whom is the agency granted its authority and/or jurisdiction--DoD, Navy, Civilian Federal Agency, State Government Regional Body, Local Government, Implementation of a Treaty or International Agreement, and the like?

What is the charter of this authority and the scope of its environmental protection and pollution control activities? What standards are enforced?

What is the position of the authority within the organizational structure of the authorizing entity and its relationship to that entity?

Of what subordinate agencies or arms is the authority composed--what is its own organizational structure?

With what other agencies does the authority share jurisdiction and otherwise cooperate or compete?

Through what mechanisms does the authority exert control?

What penalties and sanctions can the authority impose on Naval installations and activities?

What channels are available for appeal to high authority?

What mechanisms are provided for obtaining special privileges, permits, and so on?

What constitutes the total jurisdiction of the authority?

What other Naval installations and activities fall within the jurisdiction of this authority?

With what other agencies does this authority share jurisdiction?

What is the influence of this authority outside its jurisdiction?

What are the formal mechanisms for working with the authority--personnel, protocol, addresses, and so forth?

What informal channels have been established for contact with the authority?

What has been the Navy's experience in working with the authority?

What reports are required by the authority? Under what conditions and how often?

What kinds of resources are available from the authority?

Publications
Technical information
Consultation and support

Table 9 (Concluded)

What oil spills have been reported, current listing, where, ship, how much, how cleaned up?
What is the average oil concentration in the bilge water of a specific ship class? (Oil concentration in ppm should be available for each ship class)
What is the oily waste generation (gallons) per day for each class of ships both in port and at sea?
What is the current oily waste receiving and treatment capability for each Naval complex?
What type and number of ships are normally located at each Naval port?
What is the frequency of deballasting for a particular ship class?
What is the fueling frequency?
What ships are currently burning Navy Distillate fuel?
What is the operational breakdown of a power plant for a particular ship class in port?
Does a particular "unit" meet the relevant standards for given pollutants?
Where are the potential problem areas?
What is the environmental impact of switching to brand X?
Provide a report of pollution abatement success.
What Naval monitoring activities are there?
Summarizes Navy pollution sources for a given installation.
Provide a summary of complaints, etc., for the period _______ to _______, showing actions taken.
What non-Naval sources of pollution exist in the vicinity of a particular installation?
To what extent do pollutants from Naval sources contribute to total environmental pollution from all sources in a particular area?
What activities and/or supplies are prohibited or restricted within a particular locale?
What are permitted and/or preferred routes, modes of transportation, and packaging requirements for moving hazardous supplies from one location to another?

VII SOME ASPECTS OF INPUTS TO THE NEPDB

A. Data Quality

In computer jargon there is a well-known acronym that calls attention to the problem of poor data: GIGO, meaning "garbage in, garbage out." The proposed NEPDB system will be of limited value if the measurement data are of poor or unknown quality. Several things can be done to overcome potential data problems; four items are discussed here:

(1) Validation analysis
(2) Instrument calibration
(3) Independent audit
(4) Data comments.

1. Validation Analysis

Data base personnel could have predefined bounds within which various measurements are expected to fall, and daily, monthly, or seasonal patterns might be expected for certain parameters. Also, certain minimum deviations would be expected for a given parameter from one measurement to the next. It is easier to perform numerous mathematical checks if the data are computerized but, of course, checks can also be performed manually, as shown later in Figure 6. SRI recommends that provisions for such checks be included in the NEPDB system and that flags be set whenever the expected bounds, patterns, or increments are exceeded. Depending on the situation, the setting of a flag could cause (1) a query to be sent to the data source requesting confirmation, (2) a warning comment to be attached to the data

in the data base, (3) a Deficiency Assessment Report, and (4) similar attention getters.

2. Instrument Calibration

A program of periodic instrument calibration and certification could be imposed on Navy sources of measurement data. The reason for wanting to do so is obvious, but the feasibility or current existence of a calibration program is unknown at this time. It is presumed that any instrument calibration program would be preceded by an analysis of the errors resulting from uncalibrated instruments, the cost of calibration, and the suggested calibration frequency. The conceptual design is unaffected by an instrument calibration program, except the absence of such a program puts added pressure on other means of ensuring quality data.

3. Independent Audit

Reconnaissance teams are currently surveying various base installations to learn what emissions should be monitored at a given site in the near future. This suggests a long range program that could be an important tool in identifying the quality of data entering the NEPDB system. The idea is that an independent, instrumented audit team could travel from base to base, making independent readings of the measurements ordinarily taken. The organizational feasibility of an audit team is not clear; the potential benefit is certain.

Base leadership personnel are in a difficult position. On the one hand, they have the responsibility of seeing that the functional tasks of

their command are completed and that environmental protection directives are met in the process. On the other hand, they have the task of monitoring their own activities. Problem: If the chromium level in the effluent gets too high, which is affected--the plating operation or the pollution report? If the plating does not get completed on time, the officer must give an accounting to his superior. But there is no current procedure for auditing the reliability and timeliness of the effluent data. The existence of audit teams will not make the commanding officer's job easier, but it will give an independent assessment of the data quality entering into the system.

4. Data Comments

Mention was made of the fact that the setting of a data quality flag could cause a comment to be attached to the data in the data base. SRI feels that liberal use should be made of this provision. Such comments might include the observation that a value exceeded its expected limit, that the measuring instrument was recently recalibrated, that an independent reading confirmed the values reported, or anything else that might be of value to the person who must make judgements or forecasts based on those data. This conceptual design effort has assumed the existence of such comments and has provided for both their generation and subsequent use.

Information to the effect that a set of data is worthless is itself of considerable value. The data and the assessment of their quality or

lack of quality should be put into the data base even in this extreme case. Of course, such a situation must lead to an exception report.

B. Priority Criteria for Questions Entering the System

As described in Section IX, as requests enter the system, they are given a priority rating and assigned to an analyst to complete according to that priority. Criteria will need to be established so that priorities can be assigned properly. Priority criteria are considered here to allow identification within the conceptual design of features that will enable the system to respond especially well to requests with highest priority. Three possible criteria are mentioned here:

(1) Priority proportional to the level of the person asking the question (source oriented).

(2) Priority proportional to the apparent urgency of the matter giving rise to the question (situation oriented).

(3) Priority proportional to the ease with which the question can be answered (resource oriented).

1. The Source-Oriented Criterion

The source-oriented criterion is the easiest to apply because no judgement is required; a clerk or especially trained person merely consults the organization chart to know what priority should be assigned. This criterion is also well suited to an organization like the Navy, which operates on the basis of rank and formal superior/subordinate relationships. The unqualified application of this criterion carries with it the assumption that a high level source always has a more pressing need for information than a lower level source, or that it costs more (according

to some measure) to keep a high ranking officer waiting than a lower ranking officer. Herein lies the greatest drawback of this criterion because this assumption is not always true.

2. The Situation-Oriented Criterion

The situation-oriented criterion can, in principle, remedy this weakness because it focuses on the reason for the question rather than on who happens to be asking it. However, this criterion has its own drawbacks. In the first place, it is more difficult to apply consistently because of the need for both information and wisdom is evaluating a situation and assigning a priority. It also has the potential for subjecting the needs of an admiral to the judgement of the person who happens to be assigning priorities on a given day, which would be clearly unacceptable to the Navy. One could imagine users assigning a preliminary priority to their own requests. Many questions could have preassigned priorities. These may be desirable things to do anyway, but they do not eliminate the problem of the admiral being assigned an unacceptable place in the queue.

3. The Resource-Oriented Criterion

The resource-oriented criterion may optimize the throughput rate but, since there may be a positive correlation between the importance or urgency of a question and the resources required to answer it, the use of this criterion may cause important questions to wait in the queue while trivial ones are answered.

SRI's analysis of potential user questions (Section VI) has shown that one might expect the same questions to be asked by various levels of users, with the higher level user tending to ask for more generalized information and the lower level user tending to ask for more detailed information. Therefore, it seems inappropriate to assign priorities solely on the basis of a source-oriented criterion. How, then, are situation-related criteria to be applied? The NEPDB system concept provides for more detailed data to be maintained at the local bases and EFDs, and for summaries to be sent to the central data base. This is consistent with the expectation that requests asking for the most detailed information will come from the bases and EFDs themselves and thus can usually be answered without having to interrogate the central data base. It is not expected that these requests will often fall into the urgent or high priority category. Therefore, the central facility should be designed to answer the broad, complex, and urgent questions. The proposed log-in and control procedures reflect this; the overhead cost of such procedures would be too high to justify if the majority of the requests were easy-to-answer, low priority questions. Such procedures are justified when there is value in keeping firm control over schedules, priorities, and assignments, as is the case in handling complex requests.

In summary, the conceptual design does reflect the idea that some questions will be more important than others and that these questions

will be particularly well handled. There is an implicit use of situation-oriented criteria through decentralization without placing on data base personnel the task of having to apply them explicitly. It is left as a task for the detailed design to see if any other criteria ought to be applied by the data base personnel.

VIII DATA BASE COMPONENTS

A. Data Base Data Content and Organization

For a data base to be responsive to questions from data base users tasked with satisfying the above requirements, relevant, timely data of known quality must be available in and retrievable from the data base. A systematic method is needed, therefore, to ensure the identification of data needed to assist specific command, control, and research efforts of Naval personnel concerned with protecting the environment during the course of Naval operations. Once such data are identified, they must be organized for efficient retrieval. In addition, for a cost-effective data base design to be chosen, the quantity of data to be handled must be estimated. These subjects are discussed in this section.

1. Data Content

a. Data Category Identification from the Environmental Effects Framework (EEF)

Two approaches were taken to identify the data that will be needed in an environmental protection data base: (1) analysis of user questions to determine the data needed for response, and (2) analysis of an environmental effects framework to determine the data necessary for the measurement and control of the interaction between the Navy and its environment. The latter approach will be described first because use

of the environmental effects framework gives promise of identifying important data with few omissions. A nearly exhaustive list of user questions would be needed to give the same promise.

Appendix B gives a framework that describes the components of a general facility/environment/consequence framework that will be summarized here. An array of Naval facilities embedded in the natural environment and interacting with it in the manner shown is the system for which the data base must provide information.

b. The Generation of Environmental Effects

The EEF is developed by tracking material through the processes by which it is ultimately disposed in the environment and interacts with other users of the environment. A simplified and generalized scheme for this is shown in block diagram form in Figure 5. The main segments of the EEF have been designated as:

- Production-consumption
- Waste discharge
- Environmental quality
- Other environmental user effects
- Socioeconomic impacts.

1) Production-Consumption

The production-consumption cycle converts input factors into useful output and unwanted residuals. This formulation makes a distinction among raw materials, consumable supplies, and the facilities

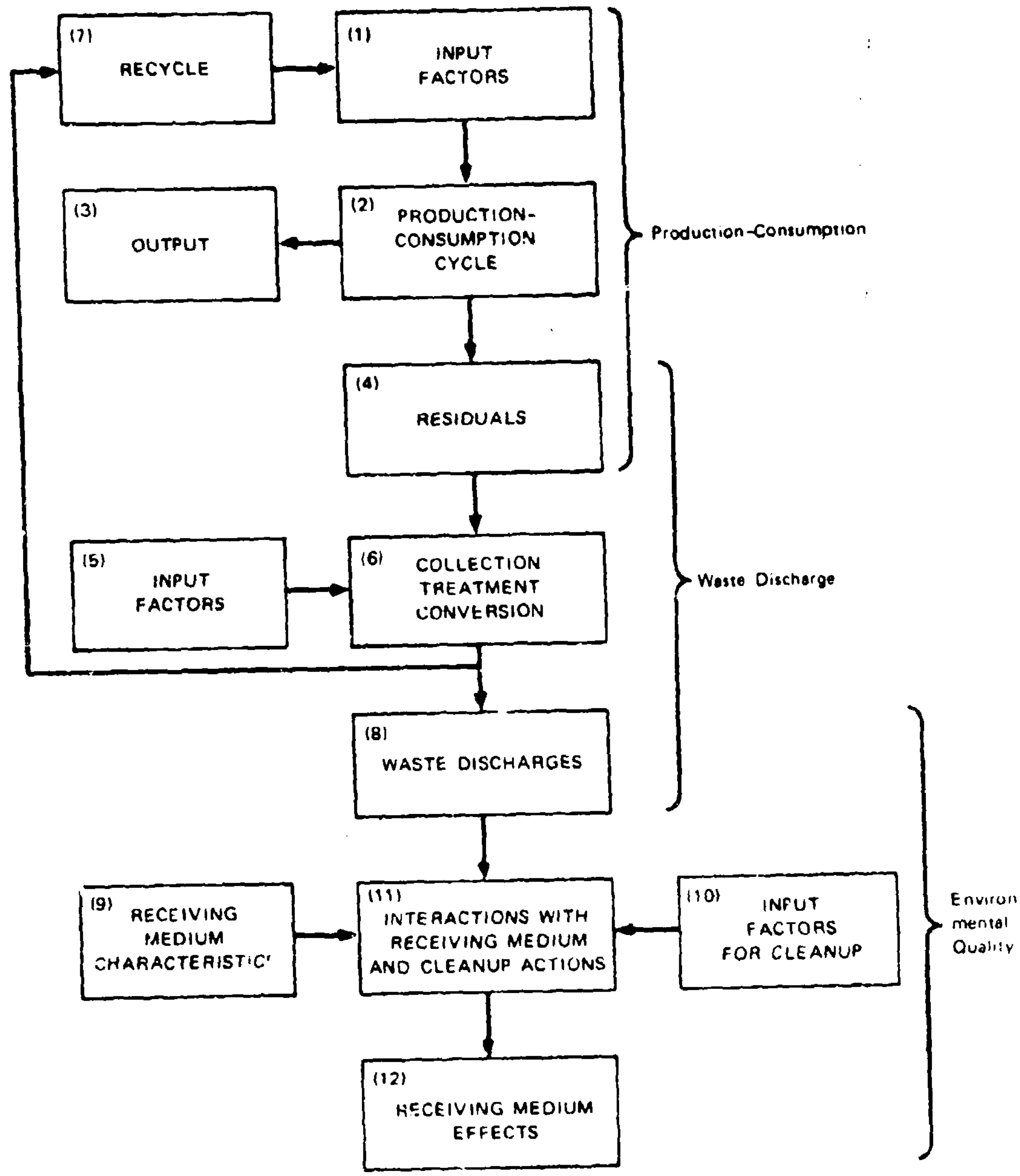


FIGURE 5 ENVIRONMENTAL EFFECTS FRAMEWORK

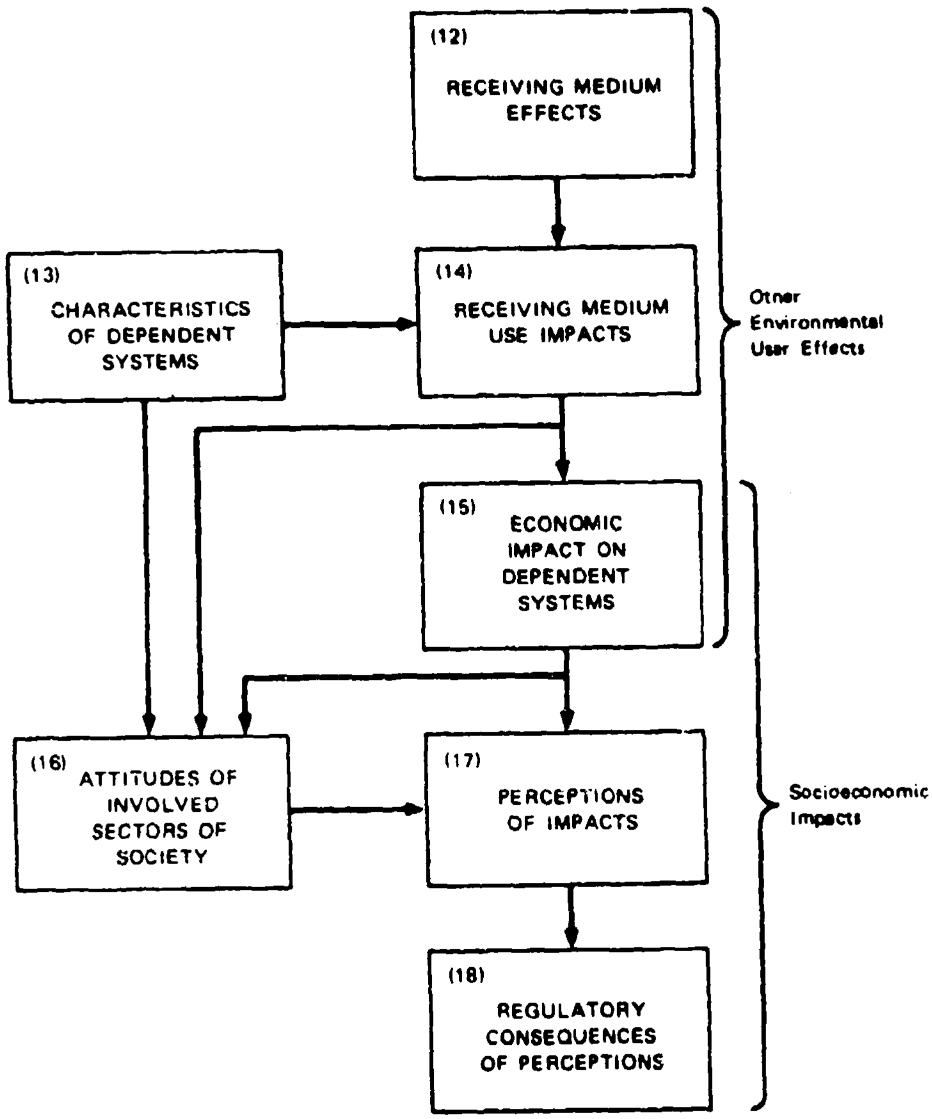


FIGURE 5 ENVIRONMENTAL EFFECTS FRAMEWORK (Concluded)

by which they are used in processing, production, and operations. The basic concept is that of an energy-material balance. This may be set up on the basis of the steady state operation of a Naval facility or complex of facilities; it may be based on a unit of output or input factors at a particular stage in the production-consumption cycle; it may be the cumulative residuals generated on the basis of a facility or class of facility carried through all or part of the production-consumption cycle. The important point is that varying the dimensions of the system on which the energy-material balance is to be struck determines the type of NEPDB user question that may be addressed. Another important point is that the energy-material balance concept is a powerful tool for accounting for all residuals.

2) Waste Discharge

The residuals generated by the production-consumption cycle are candidates for recovery as valuable scrap or for disposal as unwanted wastes. This segment of the EEF is concerned with the latter category of residuals. Within limits the residuals may be collected, treated, or transformed by facilities so that they may be disposed in a more acceptable manner. For example, sewage is transformed into a gas that may be burned and a sludge that may be disposed on land or burned in an incinerator; sound may be converted to heat; waste heat may be disposed to water bodies or directly transferred to the atmosphere; certain gases may be dissolved in solutions and disposed as a liquid or

precipitated for disposal as a solid; and airborne particulate matter may be collected as a solid. The important point is that residuals are not destroyed; they are merely disposed in another form or in a different media.

The processing of residuals by facilities is analogous to the production-consumption cycle; thus the comments made above under that category hold equally well in this segment of the EEF.

3) Environmental Quality

The media--air, water, and land--on which wastes are discharged have a finite capacity for diluting, dispersing, attenuating, assimilating, or holding wastes. When the aggregate waste discharges in a region exceed this capacity, then the environmental quality of the region suffers. The geographic limits of the region that can be affected by waste discharges at specific locations are determined by complex natural characteristics of the receiving media and will not correspond for the different media. The extent to which the environmental quality characteristics of a receiving medium can be affected by waste discharges in terms of both space and time provides further dimensions for addressing user questions to the NEPDB.

Waste materials will interact with the receiving medium and will be transformed or removed at rates that are characteristic of the waste material and the available waste handling or assimilative

capacity of the receiving medium. In addition, under certain conditions the contaminated receiving medium can be treated or processed to remove certain materials and thereby improve the environmental quality.

4) Other Environmental User Effects

The receiving media for wastes comprise the living environment for biological systems. A change in the physical or chemical characteristics of the receiving media can therefore affect the life processes of these dependent biological systems. These effects can be directly on an organism itself or can be felt indirectly through the ecological interrelationships of the various species.

The human organism differs from other species in its response to environmental quality in at least two important aspects. First, humans can process environmental components to an acceptable level of quality, e.g., drinking water; but humans look to the environment for more than life support needs. Second, humans use the environment as a resource to support a desired life style or standard of living. These uses have both environmental quality requirements and environmental quality effects. Therefore, when a change in environmental quality occurs because of some perturbation in the usage structure in a region, some uses are made more or less desirable. Benefits are transferred to those sectors of society whose uses are made more desirable or whose increased usage is responsible for the change in environmental quality. On the other hand, other sectors of society find that either they must bear an

additional burden of cost to process an environmental component to an acceptable level of quality so that they may maintain their desired level of use, or they must reduce their usage.

The shifts in usage patterns that accompany a change in the physical and chemical characteristics of the receiving media cause conflicts among the users of the environmental components. These conflicts result in stresses and disruptions in the organizations through which humans interact.

The organization of biological organisms that are affected by a change in the environmental quality characteristics of a receiving medium presents a further dimension to which NEPDB user questions may be directed. Some categories for organization include biological classification according to: organism types, a hierarchical ordering, environmental component dependency, ecological interrelationships, and social organization and economic interactions.

5) Socioeconomic Impacts

The social consequences of the impact on biological systems resulting from changes in the environmental quality characteristics of the receiving media depend on the perception of these impacts by groups whose interests are believed to be affected. The perceptions, in turn, are influenced by the attitudes of these interest groups toward the changes that are perceived and the activities that are believed to be responsible for these changes.

The social consequences that may take place may take many forms. Normally, sustained complaints ultimately lead to new standards and regulations. If there are no credible institutionalized mechanisms for addressing the perceived impacts, then these consequences may become disruptive.

2. Data Categories

Keying to the environmental effects framework in Figure 5, possible data categories for the NEPDB are listed in Table 10. Categories 1 through 4 concern the location, operation, monitoring, and control of the production-consumption and waste discharge cycles in the environmental effects framework. Data categories 5 through 7 describe environmental characteristics, monitoring, and standards in the environmental quality bracket; categories 8 and 9 contain data for other environmental user effects; and category 10 documents the response of other users to socioeconomic impacts that results in eventual regulatory action, both formal and informal.

Typical data content that might be stored in the above categories are shown in Table 11, and specific included data are described in more detail in Appendix B. The notation used in Table 11 is one that is generally associated with automatic data processing, but the intent is not to imply a requirement for such processing. Instead, the notation is a convenient mechanism for identifying interrelated data categories

Table 10

PROPOSED NEPDB DATA CATEGORIES:
FACILITY-ENVIRONMENT-CONSEQUENCE INTERACTION ORIENTED

1. Facility Locations and Jurisdictions
2. Facility Operating Characteristics
3. Quality of Facility Operating Characteristic Data
4. Facility Operation Regulations
5. Environmental Quality Characteristics
6. Quality of Environmental Characteristic Data
7. Environmental Quality Regulations
8. Other Environment User Locations and Jurisdictions
9. Effects of Environmental Change on Other Users
10. Response of Populace to Perceived Effects

Table 11

CONTENT OF PROPOSED NEPDB DATA CATEGORIES: FACILITY-ENVIRONMENT-CONSEQUENCE INTERACTION ORIENTED

Data Category	Parameters
1. Facility Locations and Jurisdictions LF (I, J, K, T)	I - Facility type (individual or aggregate) J - Physical location (grid number) K - Jurisdictions Navy Non-Navy T - Time
2. Facility Operating Characteristics CFO (I, J, L, T)	I - Facility type J - Physical location L - Operating characteristics Input factor data Nominal Monitored Production-consumption cycle data Residual data Nominal Monitored Treatment or conversion data Waste discharge data Nominal Monitored T - Time

Table 11 (Continued)

Data Category	Parameters
3. Quality of Facility Operating Characteristics Data QCFO (I, J, L, M, T)	I - Facility type J - Physical location L - Operating characteristic M - Quality of datum in CFO (I, J, L, T) location Accuracy Range of validity Perishability T - Time
4. Facility Operation Regulations RFO (I, J, L, N, T)	I - Facility type J - Physical location L - Operating characteristic N - Regulations Navy Non-Navy T - Time

Table 11 (Continued)

Data Category	Parameters
5. Environmental Quality Characteristics CEQ (J, P, Q, T)	J - Physical location P - Environmental component Water Air Land Q - Environmental quality and quantity characteristics T - Time
6. Quality of Environmental Characteristic Data QCEQ (J, M, P, Q, T)	J - Physical location M - Quality of datum in CEQ (J, P, Q, T) location Accuracy Range of validity Perishability P - Environmental component Q - Environmental quality or quantity characteristic T - Time

Table 11 (Concluded)

Data Category	Parameters
7. Environmental Quality Regulations REQ (J, N, P, Q, T)	J - Physical location N - Regulations Navy Non-Navy P - Environmental component Q - Environmental quality or quantity characteristics T - Time
8. Other Environment User Locations and Jurisdictions LOU (J, K, R, T)	J - Physical location K - Jurisdictions R - User type (individual or aggregate) Biota Industrial T - Time
9. Effects of Environmental Change on Other Users	
10. Response of Populace to Perceived Effects	

and alternate access dimensions to data. For example, the first data category, Facility Locations and Jurisdictions, may be accessed by specifying a facility type to obtain a set of physical locations or by specifying a physical location and to obtain a set of facility types. In one case facility type acts as an indexing dimension and in another case as the data to be acc sed. The second case represents an inversion of the first. The notation of Table 11 allows all such inversions to be described compactly. The table is not meant to be exhaustive, however, or to imply a particular data base organization or structure. It is a commonality grouping mechanism considered from the viewpoint of the interaction framework for facility/environment/consequences.

In addition to direct operation, monitoring, and control data categories, reference information will be needed on facility; monitoring system; and abatement system design, installation, and operation.

a. Implications of User Question Commonality

The second approach to identifying data base content consisted of analyzing anticipated user questions and the data required to answer those questions through the mechanism of a commonality matrix. This effort was conducted in parallel with the EEF data requirements analysis. The results of the two analyses were then cross-checked and merged, leading to a final, composite specification of data base contents.

A number of options were available for selecting the set of anticipated user questions to be used in the commonality analysis. The requirements study yielded a set of potential user questions for each requirement identified. It was difficult to make a realistic assessment of the relative importance of the various questions or the frequency with which they might be asked. Accordingly, the set of questions, prepared and revised by NCEL and supplied to SRI as a part of the project documentation, was selected as being representative of the type and mix of user questions that might be anticipated. It was found to contain most of the questions identified by SRI in the requirements study. Many of the questions in the NCEL list were found to be essentially duplicates, phrased from slightly different points of view. This was taken to be an indication of the relative importance and frequency of the question.

Rather than correlating this set of anticipated user questions directly with data base contents, a set of "basic" questions was prepared. Each basic question was to yield a single data element. Most of the anticipated user questions could be broken down into a sequence of the basic questions. The commonality matrix served as one mechanism for testing the completeness of the basic question set. To answer certain of the anticipated user questions, the set of basic questions had to be augmented. When the commonality matrix was completed, there was some

confidence that the set of basic questions was also complete. The set of basic questions was intended to include all significant inversions of questions.

The set of anticipated user questions, assembled from the NCEL list and renumbered, is shown in Table 12. There are 50 questions and subquestions. The initial set of basic questions from which the commonality matrix was formed is shown in Table 13. The questions are grouped into 10 categories and will be described in Section X. Basically, the categories reflect the broad data categories about which the basic questions are asked. These categories are different from those used with the EEF because of the different rationales used in selecting the categories. The EEF categories are directed toward sources of data, and those shown in Table 13 are directed toward data base organization. There are 53 basic questions in the list.

The commonality matrix is shown in Table 14. Rather than simply indicating the correlation between anticipated user questions and basic questions to the data base, an attempt was made to show the order in which the basic questions might be asked. For example, user question Q9.d could be answered by first asking basic question H1. This would be followed by basic questions F2 and F1. These in turn would be followed by "correlation and analysis" to derive finally the necessary information to answer the user question. For the complex user questions there is

Table 12

TYPICAL USER REQUIREMENT QUESTIONS

Q	1.	What pollution control authorities have jurisdiction over a specific Naval installation? (addresses, etc.) What types of pollution do they control (air, water, noise)? (NAVFAC)
Q	2a.	What are the federal/state/local standards and/or regulations concerning a specific pollutant at a specific location? (NCEL and BUMED)
Q	2b.	Is there a specific report requirement? If so, what is it, who requires it, and how frequently is it needed? (NCEL)
Q	3a.	At a specific location of Naval operations, are federal/state/local standards met? (NCEL and SODIV) If not, which ones are violated?
Q	3b.	Provide design parameters and data that will signal a command that its methods of operation require scrutiny (new discharge standards, and the like) (NCEL RECON/SD)
Q	4a.	Provide analysis of data in terms of existing conditions, trends and future projections of air and water quality. (PACDIV)
Q	4b.	What are the funding requirements and level of effort required to meet new standards? What is the benefit/cost ratio for the standard? (CHESDIV)
Q	5.	How will a newly planned Naval operation affect the environmental quality at the location for which it is planned (input and assistance in preparing environmental impact standards)? (NCEL and SODIV)
Q	6.	Which Navy instructions are applicable for a certain pollution problem (air, water, solid waste)? (NORDIV)
Q	7.	What methods, equipment, and instrumentation should be used by the Navy to measure pollutants (both ambient and source) being discharged by Navy facilities? What is the cost? (OCEANAV, BUMED, NCEL, RECON/SD)
Q	8.	At a specific location, what level of personnel certification is required for qualifying as a plant operator? (WESTDIV)
Q	9a.	What pollutants are emitted by the Navy? (CNA) (BUMED)
Q	9b.	What stationary or mobile sources emit the pollutant (by specific source and by class)? (BUMED, NAVSEC)
Q	9c.	What raw materials or operations are the sources of the pollutant? (BUMED)
Q	9d.	What quantities and concentrations of the pollutant are emitted by the Navy, generally and at a given location? (BUMED, CNA, NCEL, NAVFAC)
Q	9e.	Do all Navy pollutant sources of the same type have essentially the same pollutant emissions? (BUMED)

Table 12 (Continued)

Q 10.	What are the absolute levels of emissions of different pollutants at each Navy activity so that the impact of any projected new standard may be readily evaluated? (CHESDIV)
Q 11a.	What oil spills have been reported, current listing, where, ship, how much, how cleaned up? (NAVSEC)
Q 11b.	What is the average oil concentration in the bilge water of a specific ship class (oil concentration in ppm should be available for each ship class)? (NAVSEC)
Q 11c.	What is the oily waste generation (gallons) per day for each class of ship both in port and at sea? (NAVSEC)
Q 12.	What data are available from routine measurements at specific locales? (OCEANAV)
Q 13.	What industrial hygiene effects due to a specific Navy-generated pollutant source or operation have been noted? (NIEHC)
Q 14.	Provide supplemental information for monthly waste treatment plant operating logs to facilitate the monitoring function and technical assistance to field activities in the upgrading of plant operating control procedures. (SODIV)
Q 15a.	Provide information to use as a baseline for formulating an effective pollution abatement program (PACDIV)
Q 15b.	Provide data useful for adding justification for pollution abatement projects. (PACDIV)
Q 16.	Provide data on reduction of pollution (all kinds) by facility (letters of complaint)
Q 17.	Provide a current listing of hazardous materials, pollutants, and the like for a specific area. (NCEL, RECON/SD)
Q 18.	What is the initial and steady state composition of storm drain effluents? (NURDC)
Q 19a.	What abatement practices have been planned, are being implemented, or have been constructed at a specific Naval facility? (NCEL, letters of complaint)
Q 19b.	What treatment methods or control equipment are applied to specific Navy generated pollutants? Are these the latest technology? (NIEHC)
Q 19c.	What is the present worth of pollution control facilities at a specific location or area (NC, EFD, and so on)? (NAVFAC, NORDIV)
Q 19d.	What is the cost of construction of a specific abatement program at a specific location? (NCEL)
Q 19e.	What is the cost of the maintenance and operation of a specific abatement program at a specific location? (NCEL, NAVFAC, NORDIV)

Table 12 (Concluded)

Q 20.	Analyze data to show incremental improvements in air or water quality associated with specific pollution sources and their related abatement projects. (PACDIV)
Q 21.	What is the current oily waste receiving and treatment capability for each naval complex? (NAVSEC)
Q 22.	Is an abatement process adequate to perform its abatement function at a specific time and location?
Q 23.	What are current and anticipated air and water pollution deficiencies that need corrective action?
Q 24.	What is the effect on the environment of continuing and proposed actions, programs, and facilities?
Q 25.	What training programs are needed to train personnel to handle monitoring, measuring, and abatement programs?
Q 26.	Are the operators of an abatement system competent?
Q 27.	Monitor activities to ascertain that there is no detrimental effect on the environment.
Q 28.	Provide data necessary for permits to discharge or deposit into navigable waters of the United States or their tributaries.
Q 29.	What sources of pollution and Navy installations constitute a direct health hazard to man, plants, and other animals?
Q 30.	What sources of pollution affect primarily the recreational and aesthetic value of our natural resources?
Q 31.	What aspects of a specific operation significantly affect the environment?
Q 32.	What noise hazardous areas are found within a facility?
Q 33.	What noise hazardous areas can be expected in a new or planned facility?
Q 34.	What measures are available and what has been their previous effectiveness in protecting grounds, structure, and materials from economic pests?
Q 35.	Provide information on cost and effectiveness of different aspects and equipment for cleaning up oil spills,
Q 36.	What methods to attenuate noise from a facility have been used successfully elsewhere?

Table 13

BASIC QUESTIONS TO THE DATA BASE

A. Questions about pollution and environmental control authorities

1. What is the jurisdiction of the authority, i.e., over what municipalities, counties, states, or regions does the authority exercise control?

2. What is the relationship of the authority to other authorities with which it shares jurisdiction?

3. What Naval installations and activities fall under the jurisdiction of the authority?

4. What kinds of pollution and environmental control are exercised by the authority?

5. What standards are currently imposed by the authority?

6. What standards are planned or under consideration by the authority?

B. Questions about pollution and environmental standards

1. What pollution control authority imposes the standard?

   a. Over what jurisdiction is this standard enforced?

2. What environmental elements are controlled or affected?

3. What are the standards for the environmental constituents?

4. What are the standards for monitoring and instrumentation?

5. What are the standards for control methodology?

6. What are the requirements for reporting?

7. What are the requirements for permits?

8. What are the requirements for personnel certification?

9. What is the time frame for this standard, e.g., when does it take effect?

10. What other standard(s) supersede parts or all of this standard because of more stringent requirements?

Table 13 (Continued)

C. Questions about location (geopolitical organization)

1. What pollution control authorities have jurisdiction over a particular location--municipality, county, region, state, nation?

2. What Naval installations and activities fall within the political boundaries of the location?

3. Of what regional and other superior geopolitical organizations is the location a component?

D. Questions about location (Naval installations and activities)

1. What pollution control authorities have control over a particular Naval installation or activity?

2. What Navy organizational elements are represented at a particular Naval installation or activity?

3. Within what geopolitical boundaries does the installation or activity fall, e.g., municipality, county, state?

4. What facilities are located at the installation or activity?

5. What environmental parameters are measured at the installation or activity?

6. What other Naval or civilian activities share the receiving media (and thus constitute alternate sources of pollution in the area)?

E. Questions about Naval organization

1. At what installations or activities is a particular Naval organizational element represented?

2. What Naval directives affect the operation of a particular Naval organizational element?

F. Questions about facilities

1. At what Naval installations or activities are facilities of a particular type located?

2. What are the nominal facility operating characteristics?

   a. Type and quantity of input material, supplies, and so on.

   b. Type and quantity of process residues, and so on.

Table 13 (Continued)

3. What operational parameters are currently monitored for a particular facility?

4. What instrumentation, abatement, or control equipment is implemented for a particular facility? What is the cost?

5. What reports about facility operation are currently generated?

6. What permits for facility operation have been obtained or applied for?

7. What requirements for operational personnel training and/or certification exist for a particular facility?

8. What Navy directives affect the operation of a particular facility or type of facility?

G. Questions about materials and supplies

1. What Naval facilities utilize a particular material or supply?

2. What Naval directives affect the storage, transmittal, or use of a particular material or supply?

H. Questions about environmental constituents, residues, and effluents

1. What Naval facilities produce this constituent as a residue or effluent?

2. What measurements of a particular constituent are made (by location)?

3. What are the attributes of a particular environmental constituent?

   a. Harmful to man

   b. Harmful to biota

   c. Harmful to structures

   d. Aesthetically unpleasing.

4. With what category of pollution is a particular environmental constituent associated?

   a. Air

   b. Water--sanitary or industrial waste

   c. Noise

Table 13 (Concluded)

d. Solid waste

e. Visual and aesthetic

f. Hazardous material.

5. What standards affect a particular environmental constituent?

6. What Navy directives affect a particular environmental constituent?

I. Questions about monitored parameters

1. What parameters are monitored at a particular installation or activity?

2. What standards or Navy directives necessitate a particular parameter monitoring effort?

3. What facilities at a particular installation or activity does a parameter measurement monitor?

4. What environmental constituents, process residues, and facility effluents does a parameter measure?

5. By what method and instrumentation is a parameter measured at a particular installation, activity, or facility?

6. What are the parameter values measured at a particular installation, activity, or facility?

7. What is the quality of the parameter measurement?

(Note: The Oily Waste Reporting System constitutes an example of how these questions are answered for a particular kind of monitored environmental parameter.)

J. Questions about environmental monitoring, abatement, and control

1. What techniques and equipment are available to monitor a particular environmental parameter?

2. What techniques and equipment are available to accomplish control of a particular facility or abatement of a particular pollutant?

3. What has been the Navy's experience with these techniques and controls?

4. What are the implementation and operational costs for a particular technique or method?

5. What time is required to implement a particular technique or method?

Table 11

USER QUESTION COMMONALITY MATRIX

ANTICIPATED USER QUESTIONS

BASIC QUESTIONS TO THE DATA BASE

	Q1	Q2a	Q2b	Q3a	Q3b	Q4a	Q4b	Q5	Q6	Q7	Q8	Q9a	Q9b	Q9c	Q9d	Q9e	Q10	Q11a	Q11b	Q11c	Q12	Q13	Q14	Q15a	Q15b	Q16	Q17	Q18	Q19a	Q19b	Q19c	Q19d	Q19e	Q20	Q21	Q22	Q23	Q24	Q25	Q26	Q27	Q28	Q29	Q30	Q31	Q32	Q33	Q34	Q35	Q36	Totals
A1																																																		-
A2																																																		-
A3																																																		-
A4	2	2	2																				3																2		3	2								7
A5		3	3	3	3						2												3														3													7
A6					3		3																														3													3
B1			(1)																																																1
B2		4		4	4		4																		4												1				4									7
B3		4		4	4		4																4		4												1				1									8
B4		4		4	1		4																4		4												1													7
B5		4		1	1		1																		4												1													6
B6		4	3	4	4		4																4		4												1													8
B7		4		1	1		1																1		4												4					3								8
B8		1		1	4		4				3												4		4												4		1											9
B9		4			4		4																		4												4													5
B10		4		4	1		4																		4												1													6
C1		(1)	(1)																																															2
C2																																																		-
C3																																																		-
D1	1	1	1	1	1	1	1				1												1														1	1	1		1	1									14
D2																																																		-
D3																																																		-
D4				2	2		2	1			1												2	1	1	1	(1)		1		1	1	1				2	2							1						17
D5				2	2	2	2																2			1			2								2	[illegible]			2										10
D6																								1	1																										2
E1																																																		-
E2																																																		-
F1															3		2																																		2
F2				3	5		5	2		1		1		2	2	1	1		1	1				2	2		(2)							1			5	3							2	1	1				21
F3				5	5		5	2		2													5	2	2				3					2			5													11
F4				5	5		5	2		2													5	2	2	2			3		2		2	2	2		5													15
F5				5	5		5																5		2	2											5													7
F6				5	5		5																5		2	2											5													7
F7				5	5		5				1												5		2													5		1											8
F8				5	5		5			[illegible]	[illegible]														2													5													7
G1																											1																							1
G2																																																		-
H1													1	1	1													2								1															5
H2																		1										2																						2
H3								3														1		3	3													4					1	1							7
H4								3																3	3		1										4													5
H5		(2)	(2)																		2		3	3																										5
H6									1														2		3	1																										4
I1																					1								3										5														3
I2																																																		-
I3				6	6		6															2		6					4									6													7
I4				6	6	3	6														2							5						3			6	5													9
I5				6	6		6			1											2							5									6													7
I6				6	6	3	6														2		6					5						3			6	5			5									11
I7				6	6	3	6			1											2		6					5						3			6	5			5									12
J1					8		9			5													8		2																										5
J2					8		9																8		5					1		2			1													1	1	1	10
J3					8		9			5													8		5					2		2				1											2	2	2	11
J4					8		9			5													8		5						3	3	3																3		9
J5					8		9			5													8		[illegible]																										5
Correlation & Analysis				7	7	1	7	1		6	6	2			1		1	2				1	7	4	6	3		6						1			7	6			6										21
Answer																						[illegible]		[illegible]				[illegible]													[illegible]											4

no single sequence in which the basic questions need to be asked; in such cases the matrix shows one possible sequence. Where there are major alternate sequences of basic questions, these are indicated in parentheses. Table 14 also indicates user questions for which correlation, analysis, and interpretation of the data may be required, and the cases in which the ability of the basic questions to satisfy the user demand is questionable.

A number of conclusions can be drawn immediately. First, there is a definite distinction between simple and complex user questions. Simple user questions are those that require only two or three basic questions to answer and are directly satisfied by the data base contents. Complex user questions are those that require multiple access to the data base and analysis of the collected data. This information is useful in deciding staffing and staff loading for the NEPDB system.

Second, by examining the frequency with which the various questions are asked, the relative importance of categories and individual questions is easily appraised. Certain basic questions are asked infrequently or never. However, these are not to be immediately deleted from further consideration. Many of the questions that have little or no value for direct satisfaction of user demands have significant value for data base generation and maintenance, as will be discussed in Section X.

In fact, the commonality matrix shown in Table 14 is the second of two constructed during the user question and data content analyses. The first, preliminary commonality matrix is not shown in this report. It was built using a different, tentative classification of questions and, being preliminary, is not so instructive as the refined version of Table 14. However, the commonality matrix shown is not a final result in itself. It also is a working analysis tool from which, together with the results of the EEF study, a final set of potential data base contents has been specified.

The data base contents selected for the NEPDB system are shown in Table 15. This selection was made by considering the results of the commonality matrix and user question analysis together with the EEF study. The categorization used for the commonality matrix has been retained. The contents are shown as basic data elements to be contained under each category and presuppose the organization of the data base that will be discussed in Section X. Contents for which little or no justification is shown in the commonality matrix are those for which there is a requirement to complete the data base organization or to allow suitable data base maintenance. (Such basic data elements were in fact deleted on the basis of the commonality matrix and were then reintroduced when the data base organization was put into a final form.) The list also shows some additions found to be necessary through consideration of other

Table 15

LISTING OF BASIC DATA ELEMENTS BY DIMENSION CATEGORY

A. Pollution and Environmental Control Authorities

Key: Name of Pollution or Environmental Control Authority

1. Geopolitical jurisdiction of authority
2. Naval installations and activities within the jurisdiction of the authority
3. Scope of the authority, e.g., governmental agency granting authority, statutory limitations, relationship to other authorities, and so on
4. Charter of the authority, e.g., kinds of pollutants controlled, and so on
5. Indices to current standards imposed by the authority
6. Indices to pending or planned standards
7. Contacts: who, where, procedures, previous experience
8. Description of mapping from Statutory Standard identification to NEPDB index.

B. Pollution and Environmental Control Standards

Key: Uniform index established or adopted for NEPDB system

1. Pollution or environmental control authority issuing and enforcing the standard
2. Environmental constituents, pollutants, and/or effluents controlled or affected
3. Standards for environmental constituents (summarized)
4. Standards for control methodology (summarized)
5. Standards for monitoring and instrumentation (summarized)
6. Reporting requirements (summarized)
7. Permit requirements (summarized)
8. Personnel certification requirements (summarized)
9. Date on which this standard became (becomes) effective
10. Indices to standards that supersede or override this one.
11. Access information to locate full text of standard
12. Contacts in Navy having previous experience with or responsibility for this standard: who, where, and so on

C. Geopolitical Locations (Hierarchical)

Key: Geopolitical Status (municipality, county, regional authority, state,) and name

1. Pollution and environmental control authorities having jurisdiction over the location
2. Naval installations and activities within the political boundaries of the entity
3. Superior (and inferior) geopolitical entities

Table 15 (Continued)

D. Naval Locations (Hierarchical)

Key: Identification for Naval District, Complex, Installation, or Activity

1. Pollution and environmental control authorities having jurisdiction over the location
2. Indices to pollution and environmental control standards currently applicable to the location
3. Indices to pollution and environmental control standards pending or planned for the location
4. Geopolitical entities whose boundaries encompass the location
5. Subordinate and/or included Naval Locations, e.g., installations and activities within a complex.
6. Naval organizational elements represented at the location
7. Facilities at the location (installations, activities only?)
8. Environmental parameters and measurements made at the location (installations, activities only?), including plans for new environmental parameter monitoring
9. Abatement and control programs at the location, including plans for new abatement and control programs
10. Commanding officer: name, procedures for contacting
11. Environmental protection focal point at location: name, procedures for contacting
12. Contact at EFD serving the location: name, procedures for contacting
13. Indices to file containing complaints registered against the location

E. Naval Organization

Key: Identification of Naval Organizational Element, e.g., OP-45

1. Installations and/or activities at which organizational element is represented
2. Indices to Naval directives and instructions affecting the organizational element
3. Contact(s) within organization: who, where, procedures, and so on

F. Naval Facilities

Key: Naval Identifier for Facility (a secondary set of directories may be desirable to map from facility description to facility identifier)

1. Naval locations at which facility is found
2. Nominal facility operating characteristics
   a. Type and quantity of input materials, supplies, and the like
   b. Type and quantity of outputs, residues, and the like
3. Operational parameters instrumented or monitored
4. Abatement or control equipment currently installed
5. Reports about facility operation currently generated
6. Permits obtained or applied for
7. Requirements for operational personnel training and/or certification

Table 15 (Continued)

8. Indices to applicable Navy directives or instructions
9. Contact knowledgeable about facility operation and control: who, where, procedures, and so on
10. Location of other information about facility and its operation and requirements
11. Indices to file of complaints registered about facility

G. Materials and Supplies

Key: Naval Identification for Material or Supply (secondary directories may be desirable to map from description to identifier)

1. Naval facilities utilizing the material or supply
2. Indices to applicable Naval directives or instructions
3. Location of other information about material or supply, its uses, and so on

H. Environmental Constituents, Pollutants, and Effluents (Hierarchical)

Key: Accepted Name for Constituent, Pollutant, or Effluent (file ordered alphabetically by name with cross-references for alternative names and/or spellings)

Note: This file is hierarchical in that it should contain data about both broad categories of pollution, effluents containing various mixes, and individual components.

1. Naval facilities producing this constituent, pollutant, or effluent.
2. Measurements made of this constituent (identify either NEPDB data set or information sufficient to locate parameter measurements in other data bases)
3. Attributes:
   a. Harmful to man
   b. Harmful to biota
   c. Harmful to structures
   d. Aesthetically unpleasing
   e. Miscellaneous
4. Superior and subordinate classifications. For broad categories indicate specific constituents; for specific constituents indicate broader categories of which they are a component
5. Indices to standards affecting this constituent
6. Indices to Naval directives and instructions on this constituent
7. Instrumentation and monitoring techniques suitable for this constituent--particularly those with which the Navy has had experience (identify by reference to the Instrumentation and Measurement file)
8. Abatement and control techniques applicable to this constituent, pollutant, or effluent--particularly those with which Navy has had experience (identify by reference to the Control and Abatement file)
9. Contact(s) having experience with this constituent: who, where, procedures, and so on

Table 15 (Continued)

I. Parameter Monitoring Activities

Key: Data Set Identification

1. Parameters reported in the data set
2. Facilities monitored by the data set
3. Instrumentation and measurement techniques and procedures used
4. Description of data set quality, precision, accuracy, and the like (each element in the data set should, where possible, show both value and measurement quality)
5. Indices to data set; information sufficient to locate data set within the NEPDB or in other data bases
6. Indices to pollution and environmental control standards and/or Naval directives and instructions governing the monitoring activity
7. Contact(s) knowledgeable about this data set and the circumstances under which it was generated: who, where, procedures, and so on

(Note that the Oily Waste Reporting System constitutes one data set that can be accessed through this dimension)

J. Naval Directives and Instructions

Key: Naval Directive or Instruction Identification

1. Naval directives or instructions superseded
2. Naval directives or instructions superseding this one (Note that only currently active directives and instructions need be readily available or represented in this file)
3. Naval organizational elements affected
4. Naval materials or supplies affected
5. Naval facilities affected
6. Naval locations affected
7. Environmental constituents, pollutants, and effluents affected
8. Parameter monitoring activities affected
9. Contact for interpretation: who, where, procedures, and so on
10. Index allowing access to full text of directive

K. Environmental Monitoring and Instrumentation Techniques

Key: Accepted Name ? (extensive cross-referencing will be needed)

1. Navy experience with this technique
2. Implementation and operational costs
3. Implementation lead time
4. Training requirements
5. Alternative methods and techniques
6. Contact knowledgeable with this equipment and associated methods, procedures, and techniques: who, where, and so on
7. Index allowir access to more detailed information

Table 15 (Concluded)

L. Abatement and Control Techniques

Same as K above

M. Complaints

Key: NEPDB Complaint Accessing Number (accessed through Complaint Log, Naval Locations Directory, or Facilities Inventory)

1. Source of complaint
2. Facilities affected
3. Locations affected
4. Abstract of complaint
5. Summary of action taken
6. Party (parties) responsible for action taken
7. Cost
8. Index allowing access to full text of complaint and particulars of action taken (in Archive file)

N. Previous Questions

Key: ?

1. Source of question
2. Locations affected
3. Facilities affected
4. Question (or abstract of question)
5. Summary of action taken
6. Party (parties) responsible for action taken
7. Cost of answering question
8. Index allowing access to full particulars of question and response (in Archive file)

system trade-offs. An example is the inclusion under virtually every category of references to contacts--experts, responsible Navy or civilian personnel, and so on--from which additional data or reference can be obtained.

There are 14 categories on the list. The category on measurement and control has been divided into two categories--one for instrumentation and measurement techniques and a separate one for abatement and control techniques. This division allows for the possibility of different indexing and access mechanisms. There are three new categories: Navy Directives and Instructions, Complaints, and Previous Questions.

b. <u>Data Storage Record Examples</u>

Two examples of data storage records are given to demonstrate how the data content can be represented in terms of format and media. The first illustrates a preprinted form that could be used to represent all data shown for a single entry in the data category, Pollution and Environmental Control Standards. The 12 basic data elements for this category are intended to summarize a single pollution or environmental control standard. The full text of the standard is stored separately. It is anticipated that virtually all questions about a standard can be answered by referring to such a summary without access to the standard itself. The preprinted format provides a common representation of all standards in spite of their diverse origins and disparate original

representations. It also provides a suitable means for dissemination of information about standards to users of the data base. The cost of transferring information from the legal statement of the standard to a preestablished NEPDB format is expected to be more than repaid if repeated references to that information are made. A possible form for summarizing information about pollution and environmental control information is shown in Table 16.

The second example shows how environmental parameter measurements can be represented in the data base. What the data base requires is some indication of parameter value, measurement quality, trend, and where the measurement lies with respect to a threshold of acceptability established by the relevant standard(s). This can be communicated rather simply and directly in a graphical representation as shown in Figure 6 for a hypothetical parameter measurement. The graph simply shows on a week-by-week or other periodic basis the parameter value, together with the tolerances established by measurement technique and data quality. The threshold is shown as a horizontal line across the graph. The data reduction effort is minimal, and the data and trends are strikingly visible.

In the case of parameter values the implications for the data base are rather significant. It is estimated below that as many as 25,000 to 50,000 individual parameter values per week may be collected. To accommodate such a volume of data it will be necessary to decentralize

Table 16

NEPDB STANDARD SUMMARY FORM

NEPDB Pollution and Environmental Control (PEC) Standard Summary	
PEC Authority (Name):	Date Effective:
Pollutants/Effluents/Processes Controlled:	NEPDB Index:
Overriding Standards or Situations:	
Contacts:	
Summary of Standard:	
Control Methods Implied:	
Monitoring Requirements:	
Reporting Requirements:	
Permit Requirements:	
Personnel Certification:	

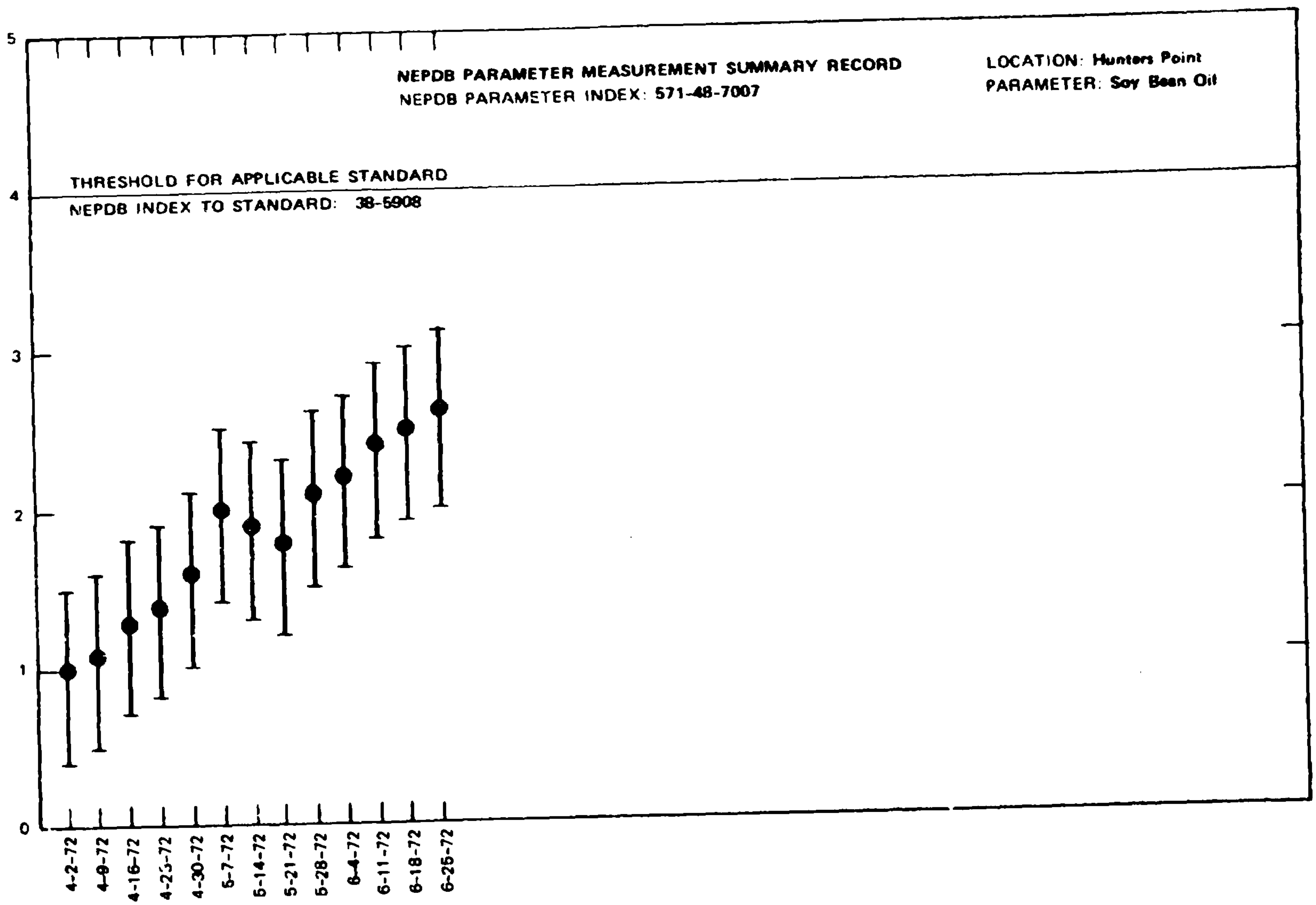


FIGURE 6 NEPDB PARAMETER MEASUREMENT SUMMARY FORM

to some degree. Decentralization requires standardization for purposes of information interchange. The data representation shown in Figure 6 is a suitable method for communicating parameter value, data quality, historical trend, and standard conformance information simply and compactly. Moreover, the representation is suitable to many different raw data media--strip charts, digital readouts, laboratory reports, and the like.

It is not the intent of Figure 6 to suggest that other data representations are not suitable but to show that rather simple mechanisms can be adopted to satisfy requirements that, initially stated, appear to demand somewhat sophisticated approaches.

B. Data Base Sources

1. Facility Types of Greatest Interest

To assist the identification of specific data sources, it is helpful to identify the types of Navy facilities most important for the purpose of environmental protection. From surveying documents and facilities at several Naval installations, the facility list given in Table 17 appears to be a useful categorization.

Table 17

TYPES OF NAVY FACILITIES OF GREATEST INTEREST TO THE NEPDB

1.	Boilers
2.	Internal combustion engines
3.	Turbine engines
4.	Petroleum-handling facilities
5.	Pesticide-herbicide application equipment
6.	Dredges
7.	Laboratories (photo and chemical)
8.	Metal surface treatment facilities
9.	Manufacturing facilities
10.	Munition processing facilities
11.	Waste treatment facilities
12.	Base connections to external utility services

2. Data Sources

From data categorization and user question analysis, six general data source categories have been identified in Table 18.

Table 18

DATA SOURCES FOR NEPDB

Facility Monitoring Systems
Regulating Agencies
Navy
Environmental Protection
Environmental Monitoring Systems
Environmental Measurement Technology Information Sources
Environmental Impact Control Technology Information Sources
Navy Facility Engineering Information Sources
External Data Banks

The first three sources provide monitoring and standards data useful for facility operation control; the last four provide reference information to assist planning and implementation of improved operations. Specific examples of data sources under each category are listed in Table 19.

C. Data Quantity

The quantity of data to be processed by the NEPDB depends on the number of facilities of the types mentioned (aggregated by activity and installation in some cases), the number of monitoring stations, the number of measured parameters, the frequency of parameter measurement, the degree of summarization of data before input to the data base, and the length of time data is kept. Discussion of each of these points follows.

1. Primary Installations with Facilities of Greatest Interest

A review of Navy installations indicates that those tabulated appear to contain most of the facilities of environmental concern.

	Navy Installation Type	Number in United States
	Shipyards	2
	Stations	20*
	Air Stations	40†
	Ammunition Depots	7
	Supply Centers	9
	Total	78

* Including 9 shipyards.

† Including 7 air reworks facilities.

Table 19

EXAMPLES OF DATA SOURCE SUBCATEGORIES

Facility Monitoring Systems
Real property inventory
Fuel consumption records
Sewage treatment plant effluent quality monitors
Industrial wastewater treatment plant effluent quality monitors
Facility operating schedule records
Facility operating cost records
Regulating Agencies
Navy instructions
Local Pollution Control District Standards
Regional Pollution Control Standards
State Environmental Standards
EPA/Corps of Engineers Standards
Complaint records
Environmental Monitoring Systems
Meteorological records
Oceanographic records
Recon Team Sensor Array records
USGS/University/ research lab records
Pollution Control District records
EPA records
Environmental Measurement Technology Information Sources
Equipment manufacturers data
University/research lab reports
Technical books
Technical journal articles
Navy experience reports
Environmental Impact Control Technology Information Sources
Equipment manufacturers data
University/research lab/pilot plant reports
Technical books
Technical journal articles
Navy experience reports
Navy Facility Engineering Information Sources
EFD reports
EFD contacts
External Data Banks/Sources
Air Pollution Technical Information Center (APTIC)
Biogeochemical Ecology Information Center (BEIC)
Defense Documentation Center (DDC)
Ecological Information and Analysis Center (EIAC)
Federal Facilities Air Pollution Inventory Program
Federal Water Quality Technical Information and Management Planning System (FWQA/TIMP)
Maritime Environmental Protection Program
National Technical Information Service (NTIS)
Solid Waste Information Retrieval (SWIRS)
Storage and Retrieval of Air Quality Data (SAROAD)
Transportation Noise Research Information Service
Water Quality Technical Data and Information System (STORET)

Considering facilities by installation is convenient because certain major facilities (waste treatment plants, connection systems to external utilities) occur one per installation, many Naval instructions and pollution standards apply installation-wide, and responsibility for collection and control of many environmental impact data may reside with an installation commander.

2. Number of Monitoring Stations

Currently, on an experimental basis Base Reconnaissance Survey Teams have monitoring stations numbering between 20 and 80 at each of three installations. On a routine basis it would be anticipated that the lower number would be more representative of a typical installation. Since the purpose of a monitoring station is to measure at principal facilities input or output flows capable of environmental impact, the number and clustering of such facilities and their input and output locations at a base will determine the number of monitoring stations required. If 25 to 50 stations are needed per installation, the total for about 80 installations would be 2,000 to 4,000 Navy monitoring stations in the United States.

3. Number of Parameters Measured and Frequency of Measurement

Although at one time or another several different air, water, solid waste, oily waste, and noise parameters have been measured, it is anticipated that the number will be approximately as follows:

Parameter Category	Number of Parameters	Percent of Monitoring Stations
Air	15	30%
Water	20	20
Solid Waste	10	15
Oily Waste	10	15
Noise	10	20

Not all stations will monitor all parameters in their category.

The frequency of measurement will be determined basically by how fast significant changes in the measurements take place. In some automated or critical processes, strip charts may continuously monitor parameters. Other measurements will be periodic--from hourly to annually; still others will be aperiodic.

If, on the average, parameters are measured or averaged weekly and the number of monitoring stations for each parameter category is as shown in the above tabulation, then U.S. Navy-wide data generation will be about 25,000 to 50,000 parameter values per week.

4. Standards and Reference Information

The above parameter monitoring concerns only measurements of facilities and their associated environment. Information on standards and measurement and control technology must also be in or available to

the data base. An estimate of the number of authorities generating standards and regulations for the regions in which the primary Naval installations lie are as follows:

Jurisdiction	Number	Average Number of Agencies	Total Agencies
National	1	5	5
State	15	3	45
Regional	20	2	40
Local	70	2	140
Total		12	230

In other words, it is expected that on the average there will be 12 separate standards that apply to each Naval installation.

Parameter Category	Number of Standards
Air	105
Water	105
Solid waste	80
Oily waste	80
Noise	80
Total	450

Reference information on facility design, parameter measurement, and abatement materiel, procedures, and experience will be in the form of books, reports, and catalogs that may be voluminous. Since large

amounts of such information may be indexed but not stored by the NEPDB, it is difficult to estimate a relevant quantity of such data to be processed by the data base.

5. Data Storage Sizing Estimates

Assuming an average of monthly summarization of weekly monitoring data and annual summarization of monthly data with perpetual retention of many annual summaries, approximately 100,000 to 200,000 parameter values, 1,000 to 10,000 data summaries, and 500 standards would be in the data base the first year, plus reference information. Annual growth might be from 500 to 1,000 summaries.

All the figures in this section constitute a set of assumptions for purposes of costing and trade-off analyses. It is anticipated that these estimates and assumptions will be refined during the detailed system design.

IX SYSTEM FUNCTIONAL COMPONENTS

A. Introduction

The purpose of the NEPDB system is to aid the Navy in fulfilling its responsibilities as set forth in DoD and Navy directives on environment protection. To this end, the system will maintain an up-to-date environmental data base in order to:

(1) Satisfy Navy user requests.

(2) Provide information to aid the Navy in anticipating problem areas.

(3) Provide information on changing standards/direction and environmental technology.

(4) Provide information to aid the Navy in environmental planning and impact assessment.

The functions that the system must perform to meet the above goals can be defined in a wide variety of ways. It is the purpose of this section to determine generic functions that the system must employ, which lays the foundation for alternative function definition in scope, quality, and detail.

The generic functions that the system uses to process user requests are:

(1 a) Entering user requests into system

(1 b) Analyzing user requests to determine data needed to respond

(1 c) Accessing basic data to be used (monitored data and standards)

(1 d) Performing necessary calculations

(1 e) Generating report to requestor

(1 f) Recording actions performed.

To provide information that will anticipate possible standard violations and problem areas, the following generic functions apply:

(2 a) Determining environmental parameter levels at specified Navy facilities on a scheduled basis.

(2 b) Performing necessary trend/prediction analyses, mathematical calculations, and the like.

(2 c) Determining standards applicable to the parameter being considered.

(2 d) Comparing parameter levels and trends/predictions to appropriate standards/directions.

(2 e) Generating reports as appropriate.

(2 f) Recording actions performed.

In the case of changes in standards/direction, time may be more critical than in the case of changes in environmental technology. In the former case these generic functions are used:

(3 a) Analyzing new standard/direction to determine types of Navy facilities affected.

(3 b) Determining which Naval facilities should be considered for deficiency assessments and scheduling such assessments.

(3 c) Determining environmental parameter levels at specified Navy facilities.

(3 d) through (3 g)--Same as (2 b), (2 d), (2 e), and (2 f).

When a change in environmental technology occurs (either new instrumentation or new discoveries on environmental parameter effects/interactions), then generic functions similar to the above are needed:

(3 h) Analyzing new environmental technology to determine types of Navy facilities affected.

(3 i) and (3 j)--Same as (3 b) and (3 c) above.

(3 k) through (3 p)--Same as (2 a) through (2 f).

Information that provides support for Navy planning in the environment protection area can include some of the data obtained using the functions described above. Further data can be provided by using:

(4 a) Location data of reports/documentation related to environmental impact that are stored in other data bases (Navy and non-Navy).

(4 b) Location data of reports/documentation/data for Navy programs related to environmental protection (abatement/construction plans and costs; Navy operating procedures affecting the environment).

(4 c) Location data of documentation/data on ecology/biology characteristics in Navy operational areas.

The above description has addressed requirements for system operation to meet the specified goals. To perform these functions, internal system functions are required to maintain a current and useful data base. These generic functions are:

(5 a) Storing and retrieving data.

(5 b) Performing data validation and confidence assessment.

(5 c) Updating the data base.

(5 d) Initiating actions to perform scheduled tasks (generate reports, assess deficiencies, and so forth).

(5 e) Providing system accounting to ensure satisfactory system operation, flexibility, and growth capability.

The generic functions defined in items (1) through (5) form a broad view of the system's functional characteristics. Since there is considerable overlap among these functions, the next logical step is to determine how the system's basic functional components can be defined. These

basic functional components can be thought of as system building blocks or subsystems. By combining common functional entities, a smaller number of pieces that make up the system can be identified.

SRI examined several ways of combining these functions to produce subsystems and found six subsystems that provide proper balances in the system structure. The reasons for selecting these particular subsystems included the identification of a system operation because of its importance to the fulfillment of the NEPDB objectives, the separation of diverse operations and the consolidation of similar operations, and the balancing needed among subsystems of system resources.

Table 20 lists basic system functions that were identified as being essential to the proposed NEPDB system. Figure 7 shows how these basic functions are highly interrelated. For example, a given function such as Data Analysis may occur several times as a particular transaction flows through the system. This is shown more clearly in Figures 8 through 13, which chart the basic functions in more detail.

B. Function 2.0: Reception and Control

Three subfunctions are identified here: Request Reception and Control (2.1), Data Reception and Control (2.2), and Log-Out (2.3). The Request Reception and Control subfunction begins with the reception of a request through the input channels. The request is transcribed into a standard form, assigned a log number, and entered in a control log. The request is then dispatched to the Scheduling and Allocation function.

Table 20

BASIC SYSTEM FUNCTIONS

1.0	Data/Request Input Channels
2.0	Reception and Control
	2.1 Request reception and control
	2.2 Data reception and control
	2.3 Log-out
3.0	Data Analysis
	3.1 Determination of data requirements
	3.2 Calculations and statistics
	3.3 Data validation and data quality assessment
4.0	Deficiency Assessment
	4.1 Event-triggered analysis
	4.2 Scheduled comparisons (time-triggered review)
5.0	Data Base Management
	5.1 Data retrieval
	5.2 Media and format conversion
	5.3 Data storage
	5.4 Update index and linkages
6.0	System Management
	6.1 Initiate unsolicited actions/reports
	6.2 Review system status and accounting statistics
7.0	Scheduling and Allocation
	7.1 Priority assignment
	7.2 Request routing and assignment
	7.3 Data batching, routing, and assignment
8.0	Report/Data Output Channels

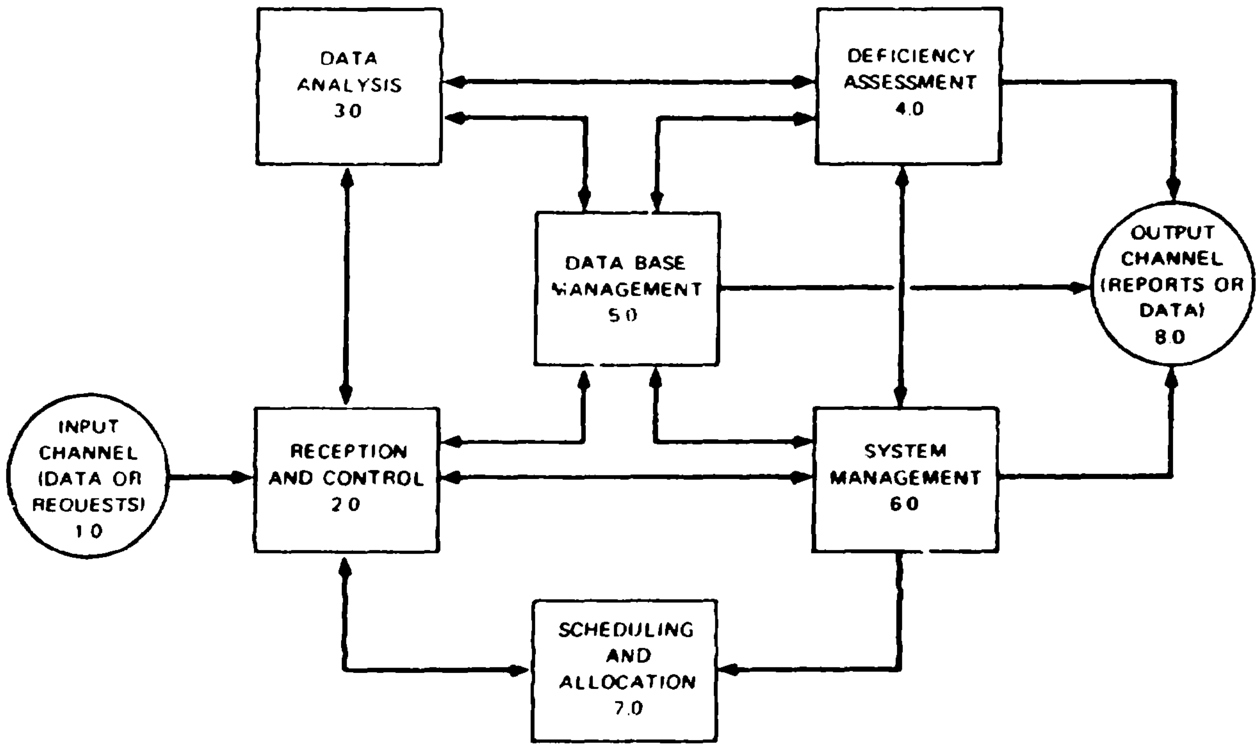


FIGURE 7 FLOW AMONG NEPDB SUBSYSTEMS

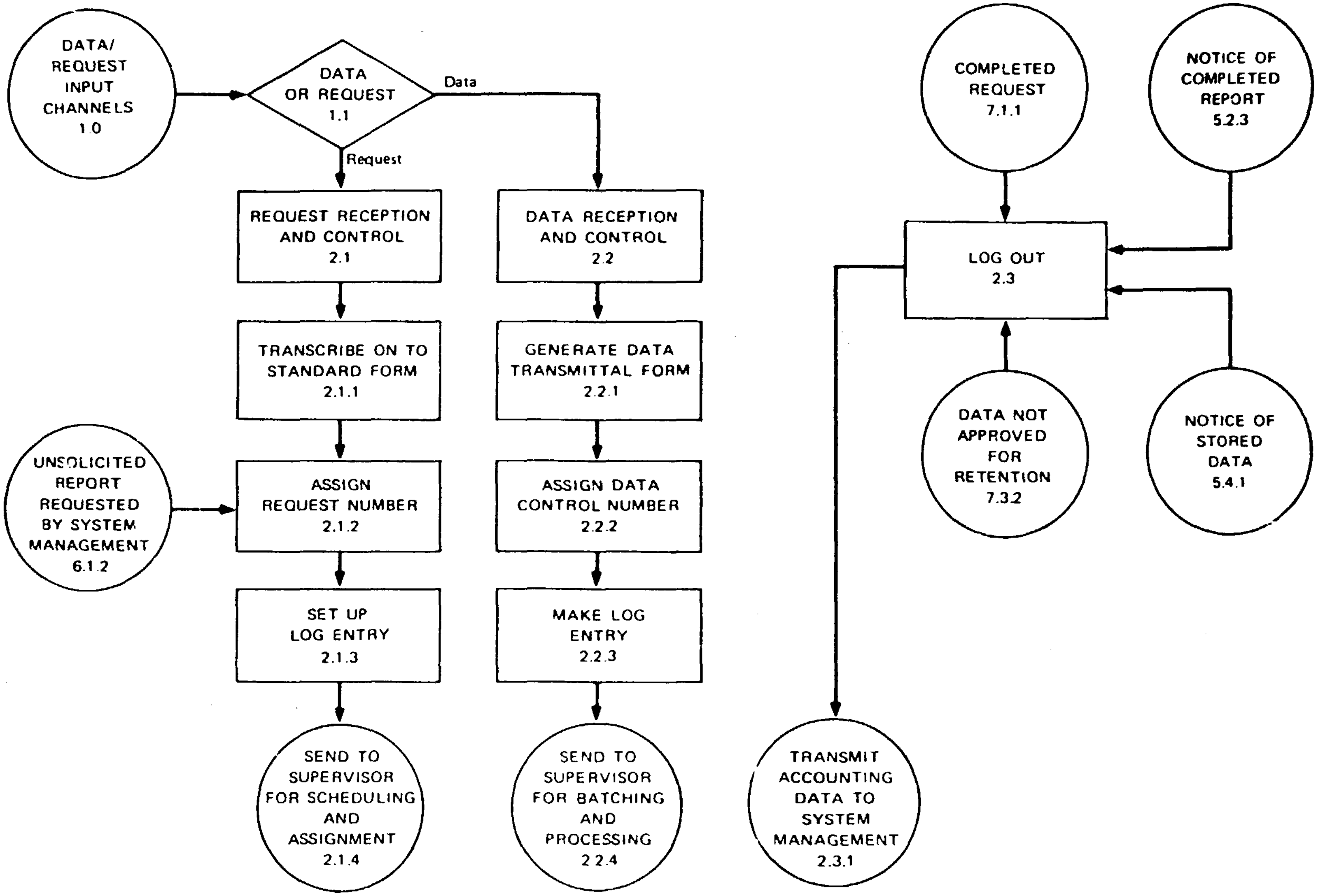


FIGURE 8 FUNCTION 2.0: RECEPTION AND CONTROL

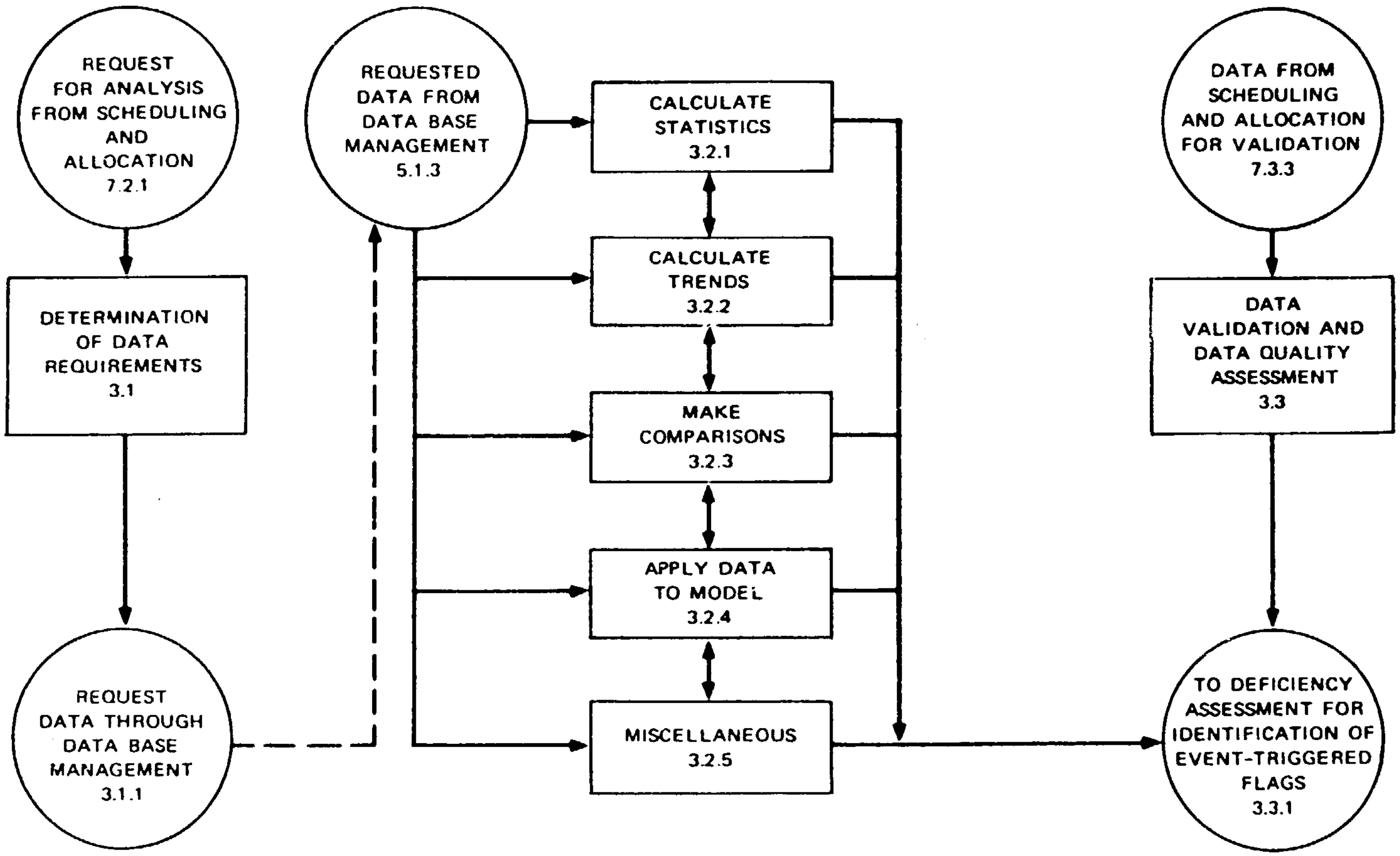


FIGURE 9 FUNCTION 3.0: DATA ANALYSIS

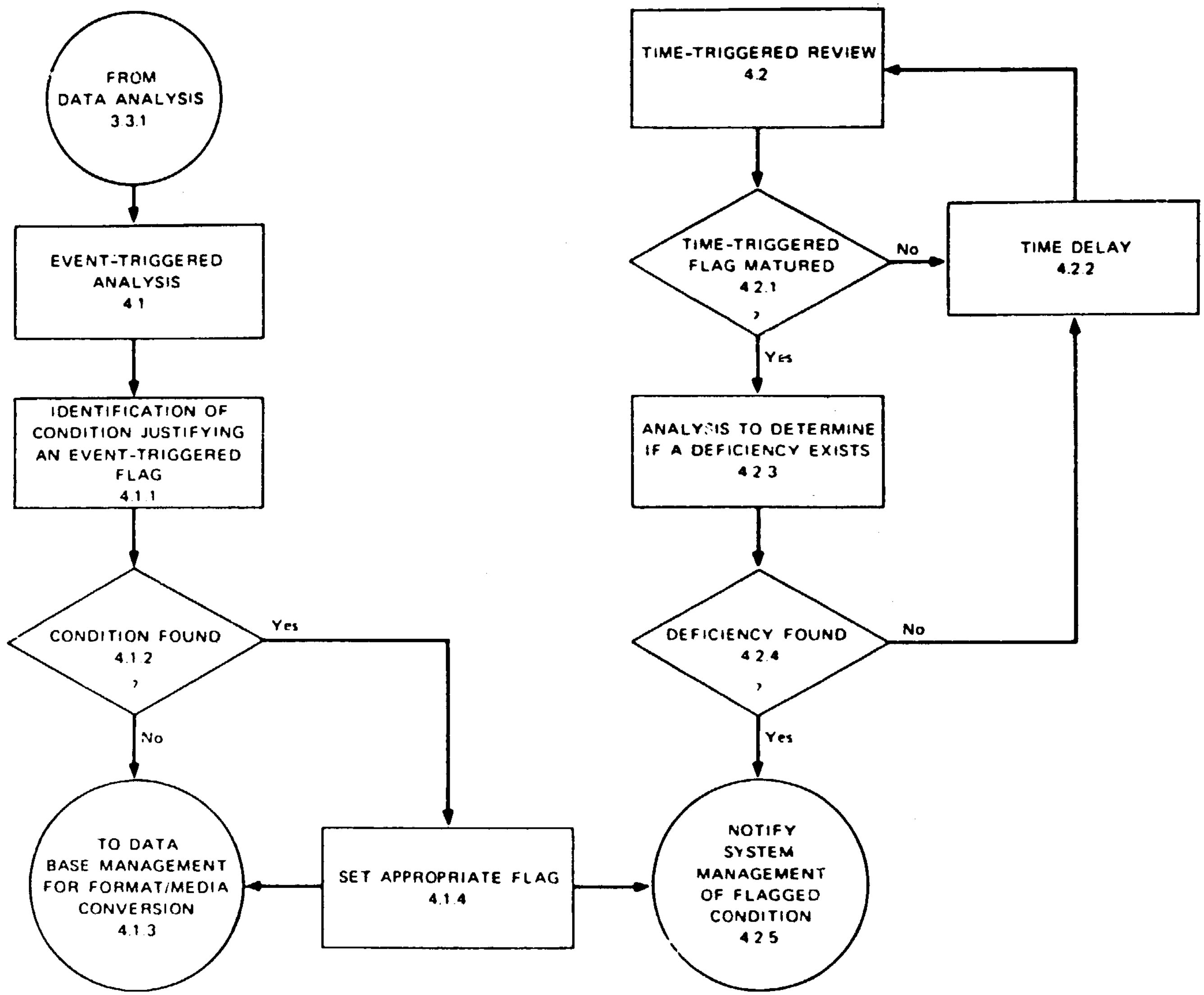


FIGURE 10 FUNCTION 4.0: DEFICIENCY ASSESSMENT

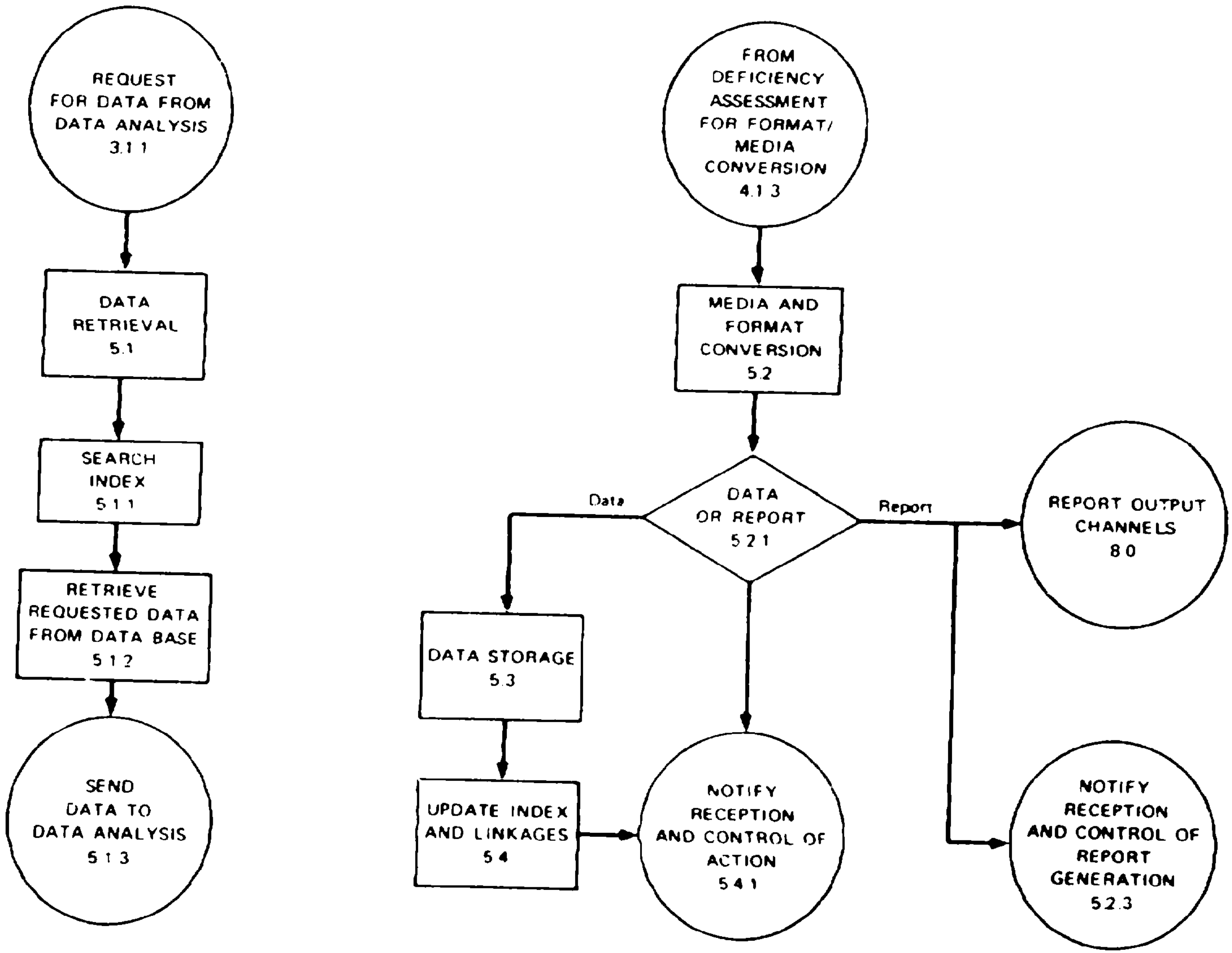


FIGURE 11 FUNCTION 5.0: DATA BASE MANAGEMENT

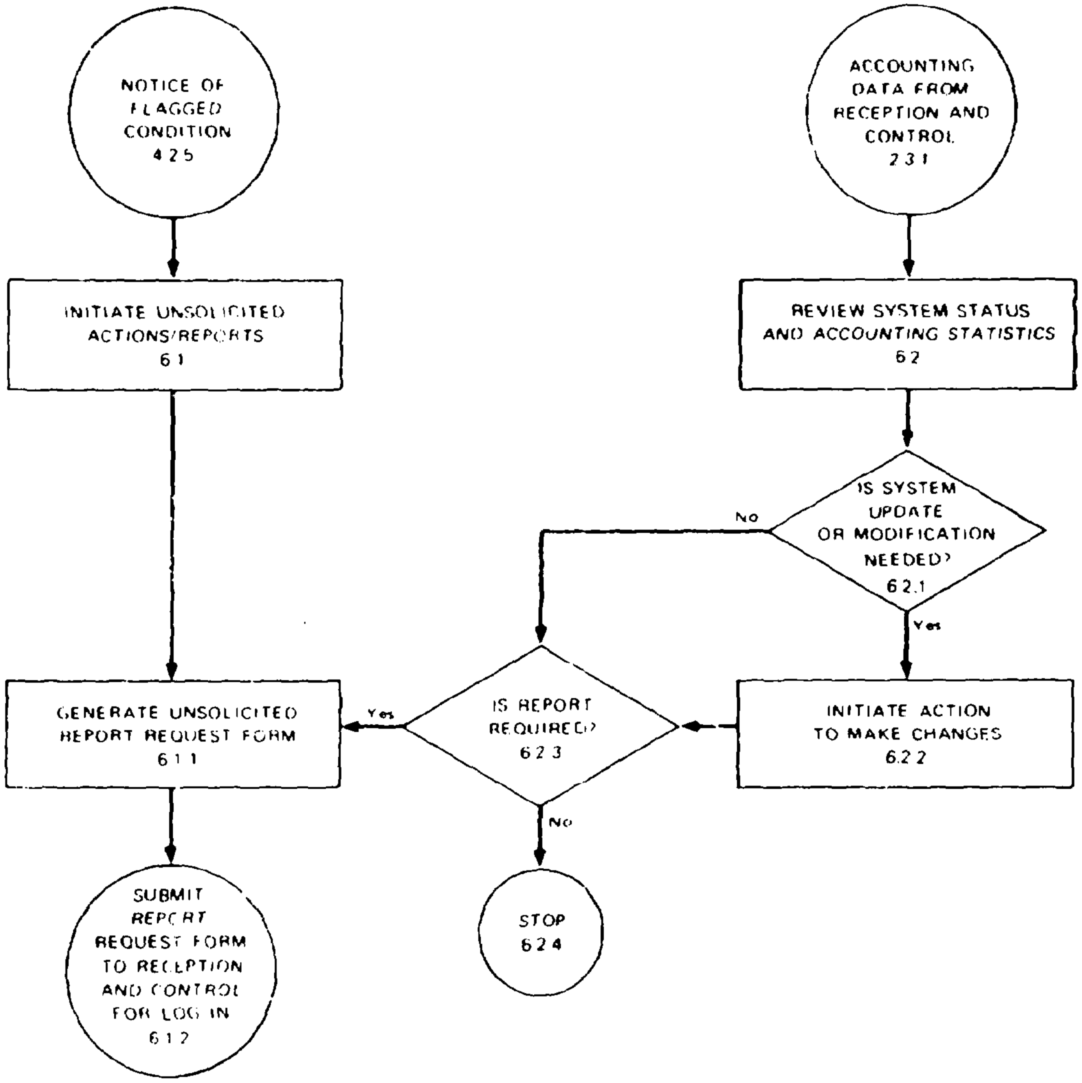


FIGURE 12   FUNCTION 6.0   SYSTEM MANAGEMENT

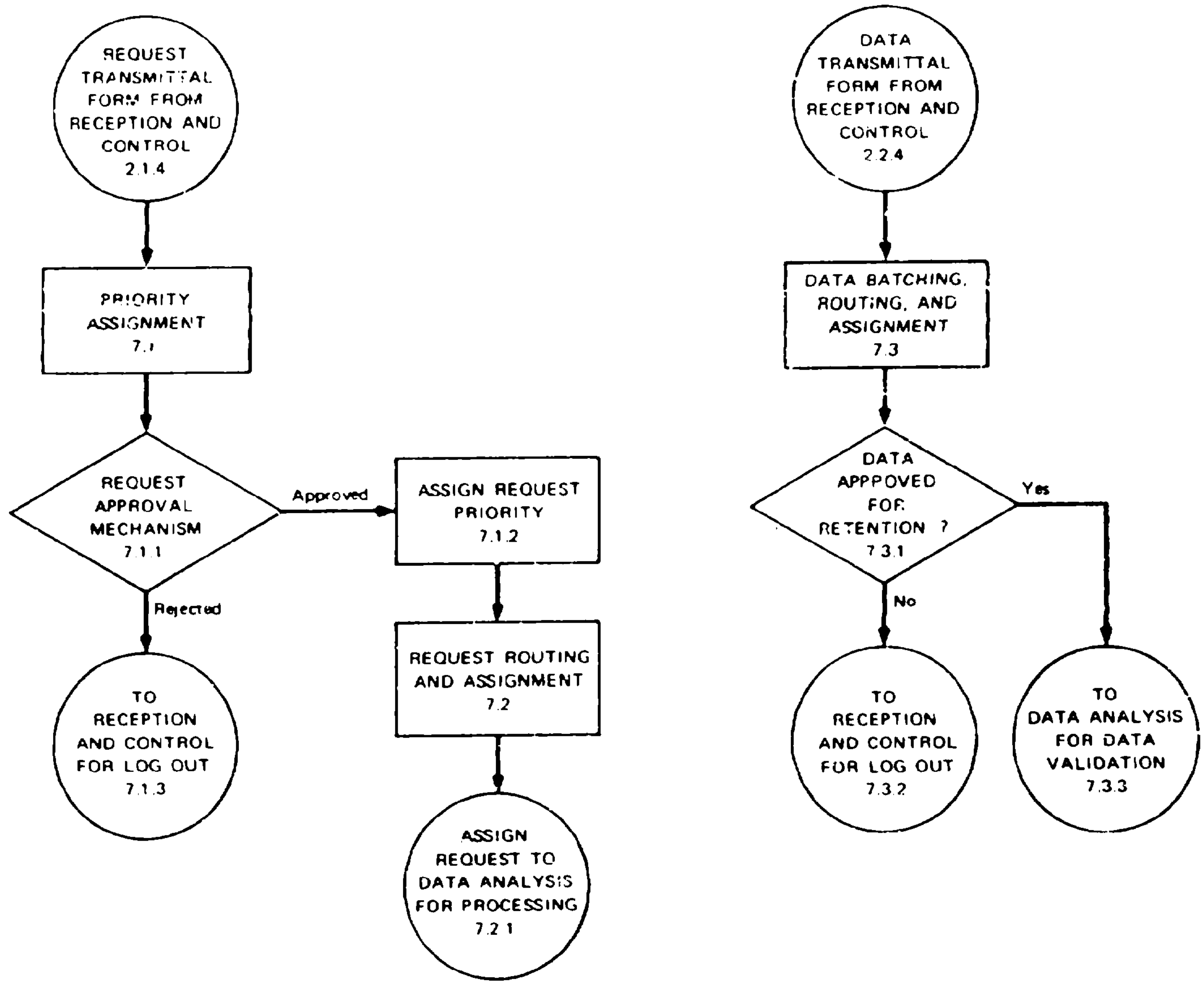


FIGURE 13 FUNCTION 7.0: SCHEDULING AND ALLOCATION

Internally generated requests (nonsolicited requests) are also handled through this procedure, as shown in Figure 8.

The Data Reception and Control subfunction is a parallel activity for incoming data. The data are logged in, assigned a control number, and dispatched to Scheduling and Allocation for further processing.

Whenever a transaction (e.g., processing an externally generated request) is completed, Reception and Control is notified so that the Log-Out subfunction may be completed. Periodically, system statistics accumulated by the log control clerk are transmitted to the System Management function for analysis.

C. Function 3.0: Data Analysis

There are three subfunctions: Determination of Data Requirements (3.1), Calculations and Statistics (3.2), and Data Validation and Data Quality Assessment (3.3). (See Figure 9.) When a request on the system has been accepted and assigned for processing, there must be a determination of the data required to satisfy that request. The Data Base Management function is then called on to retrieve the required data from the data base.

When the requested data have been received from the data base, various calculations and comparisons will have to be made with the data. In Figure 9 an attempt is made to show the interactive nature of the various mathematical/analytical techniques that may be required in any given case.

As data enter the system for possible incorporation in the data base, they must be checked for completeness and reasonableness. Data that are incomplete, inconsistent, or possibly doctored should be flagged and, depending on the importance of the data and the resources of the system, verified at the data source.

As a result of calculations on the data or the initial validation procedure, items may come to the attention of data base personnel that require special action or reports. For example, a steadily rising level of a particular pollutant, although still within standard, should perhaps be called to the attention of cognizant personnel. Or there may be a standing order to generate a special report when certain conditions are made evident by an analysis of the data. Such occurrences are acknowledged by setting what are referred to as event-triggered flags. In effect, the event-triggered flag is a mechanism for bringing a special condition or situation to the attention of the System Management function so that appropriate action can be initiated. The mechanism allows special cases to be accommodated within the procedures established for the system and provides for the exercise of effective control of total system operations through the System Management function.

D. Function 4.0: Deficiency Assessment

Deficiency assessment is in fact a special case of the Data Analysis function. It is called out separately here to emphasize the important role it plays in satisfying the objectives for the NEPDB system and to

indicate the conditions under which the Deficiency Assessment function is invoked.

The Deficiency Assessment function is invoked under two rather different sets of circumstances. The first of these--referred to as event-triggered--has been identified above. A condition requiring special attention is identified during data analysis with request processing or validation of new data. The condition is communicated to system management through the setting of an event-triggered flag, and the System Management function initiates appropriate action, generally the preparation of a Deficiency Assessment Report. The second mechanism by which the Deficiency Assessment function is invoked is referred to as a time-triggered flag. This is a means by which periodic, scheduled reviews can be initiated by system management. When a time-triggered flag matures, the System Management function initiates a review to determine if a deficiency exists. If so, appropriate action is initiated.

The time-triggered flag is in effect a mechanism whereby internal requests to the data base system are generated through the System Management function according to a preestablished schedule.

The Deficiency Assessment function can be considered to consist of two subfunctions. The first is the initial detection of a deficiency or other condition that requires special, unsolicited system action. This may occur either as part of the data analysis associated with an external request or new system data, or as a special data analysis

initiated internally to the system in response to a matured time-triggered flag. The second subfunction is the in-depth analysis of the deficiency to support the generation of an unsolicited Deficiency Assessment Report. This second subfunction is always initiated through the System Management function. These subfunctions are shown in Figure 10.

E. Function 5.0: Data Base Management

This function covers those activities that relate to the data base and enable input to and retrieval from the data base. Four subfunctions are identified: Data Retrieval (5.1), Media and Format Conversion (5.2), Data Storage (5.3), and Update Index and Linkages (5.4). (See Figure 11.) When the Data Analysis function requests data, the Data Retrieval subfunction interrogates the index, retrieves the requested data, and provides the requested data for completion of the analysis.

As data come into the system and as reports are generated for distribution, it may be necessary to convert both format and medium. That is, data may have to be keypunched or computer output may need to be put on microfilm for storage, and so on.

As data are added to the data base, the index files and the cross-reference linkages must be updated so that the data may be located efficiently when desired.

F. Function 6.0: System Management

This function covers activities that govern or monitor the overall operation of the system. Two subfunctions are: Initiate unsolicited

Actions Reports (6.1) and Review System Status and Accounting Statistics (6.2). (See Figure 12.) Once the need for an unsolicited report or other action has been identified by means of event- or time-triggered flags, the System Management function acts as if it were the requestor of such an action; it causes a request form to be logged into the system as if the request came from an external source.

The periodic accounting data that come out of the log clerk, as mentioned under Reception and Control, are analyzed and, on the basis of that analysis, changes in the system may be recommended or reports may be generated.

G. Function 7.0: Scheduling and Allocation

This function refers to the flow of tasks and assignments within the system. Three subfunctions are identified: Priority Assignment (7.1); Request Routing and Assignment (7.2); and Data Batching, Routing, and Assignment (7.3). (See Figure 13.) It is expected that at least part of the time there will be more tasks to perform than the system personnel can handle. In other words, queues will build up from time to time. It is also expected that on occasion a high priority request will enter the system that will require some personnel to halt their current tasks until the high priority item is satisfied. For these reasons a priority assignment subfunction is provided for. Once a task priority is assigned, it must then be assigned to a particular person for completion and routed through the system. It is important to centralize this assignment and scheduling function to maintain an effective control over total system resources.

Once the basic functions have been divided into subfunctions, the subfunctions can be subdivided into greater detail. Two such examples are included here. Figure 14 contains a more detailed look at the accounting activities indicated in Figure 8, item 2.3.2. Although other statistical data may be desirable and some of the data suggested in Figure 14 may not be desirable in all situations, the basic framework for monitoring the system activities and evaluating those statistics is set forth in this figure.

Figure 15, breaks down further the activities indicated in Figure 12, subfunction 6.1. A portion of Figure 10 is also repeated for convenience. This figure suggests the existence of certain files to which a clerk can refer to determine what actions are appropriate in a given case. The requirements for time-triggered actions can be modified by changing the Date Tickler file and/or the instructions in the Reference file.

It is clear from the above discussion of basic functions that not all the activities associated with a given function are performed consecutively or necessarily by the same individuals. It also is apparent that a given individual may perform activities classified under different functions. It is therefore necessary to approach the data base system activities from a sequential perspective as well as a functional one. A broad look at the system activities from a sequential point of view is shown in Figures 16 and 17.

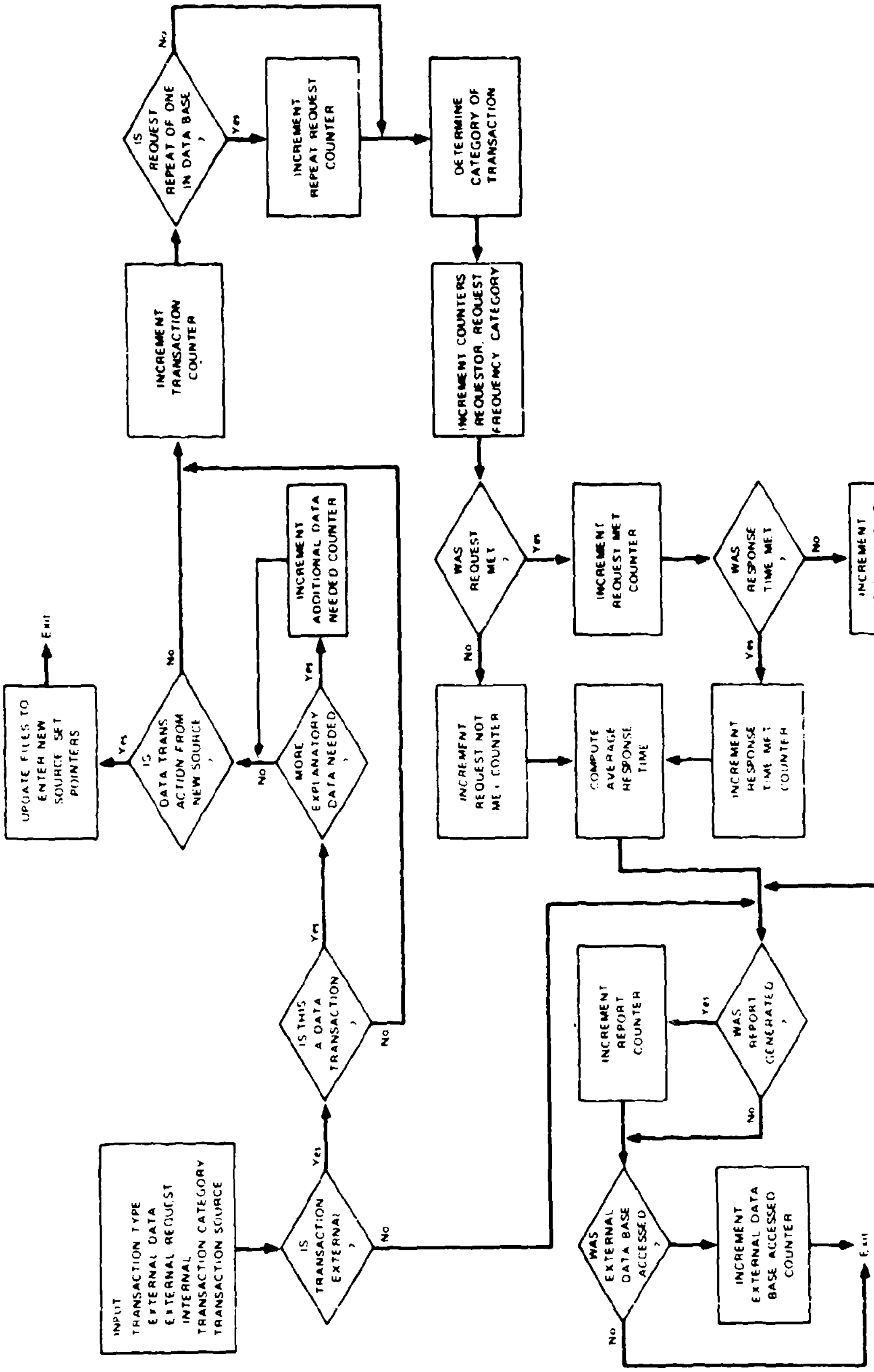


FIGURE 14 ACCOUNTING SUBFUNCTION

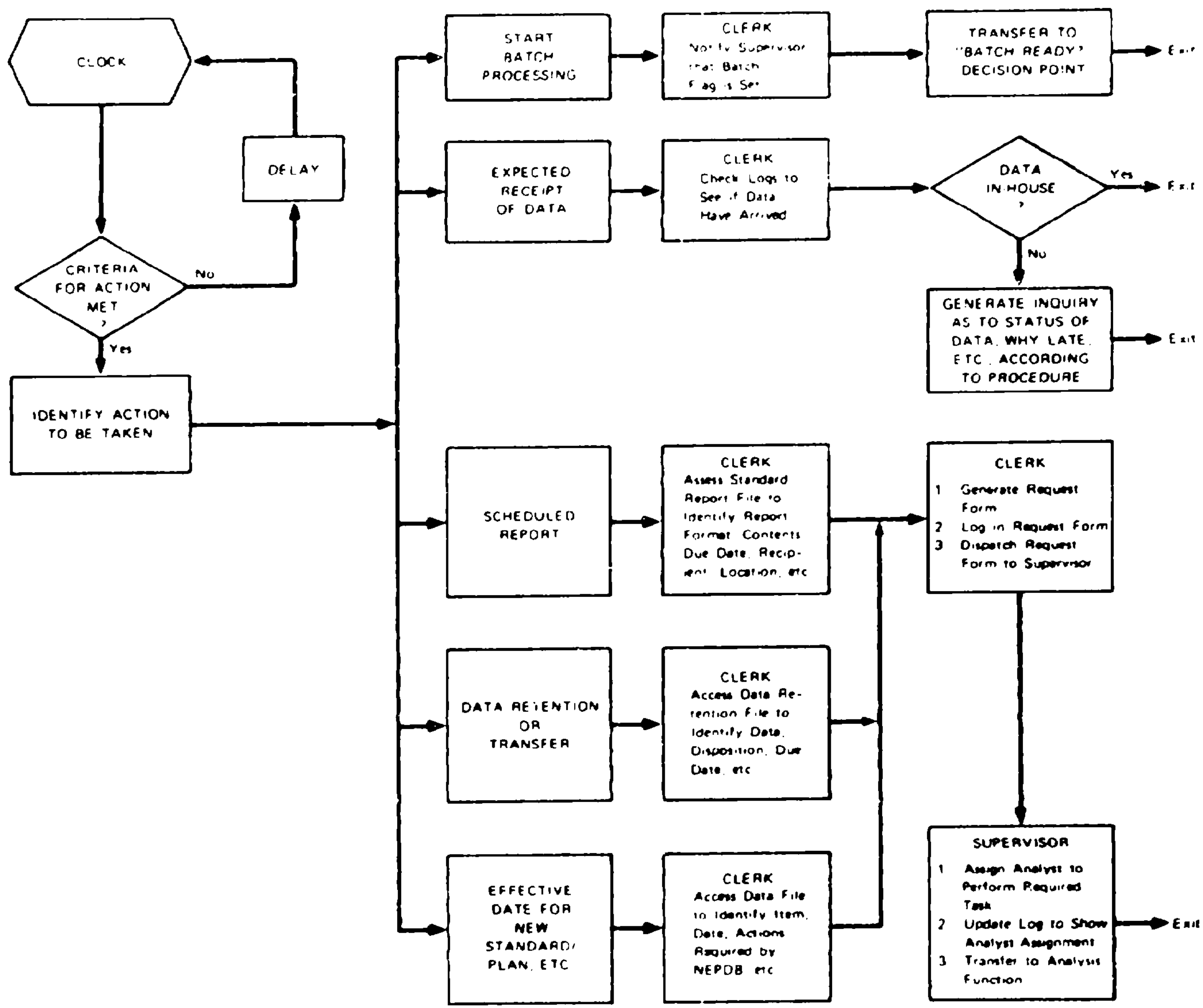


FIGURE 15 PROCESSING OF TIME-TRIGGERED ACTIONS

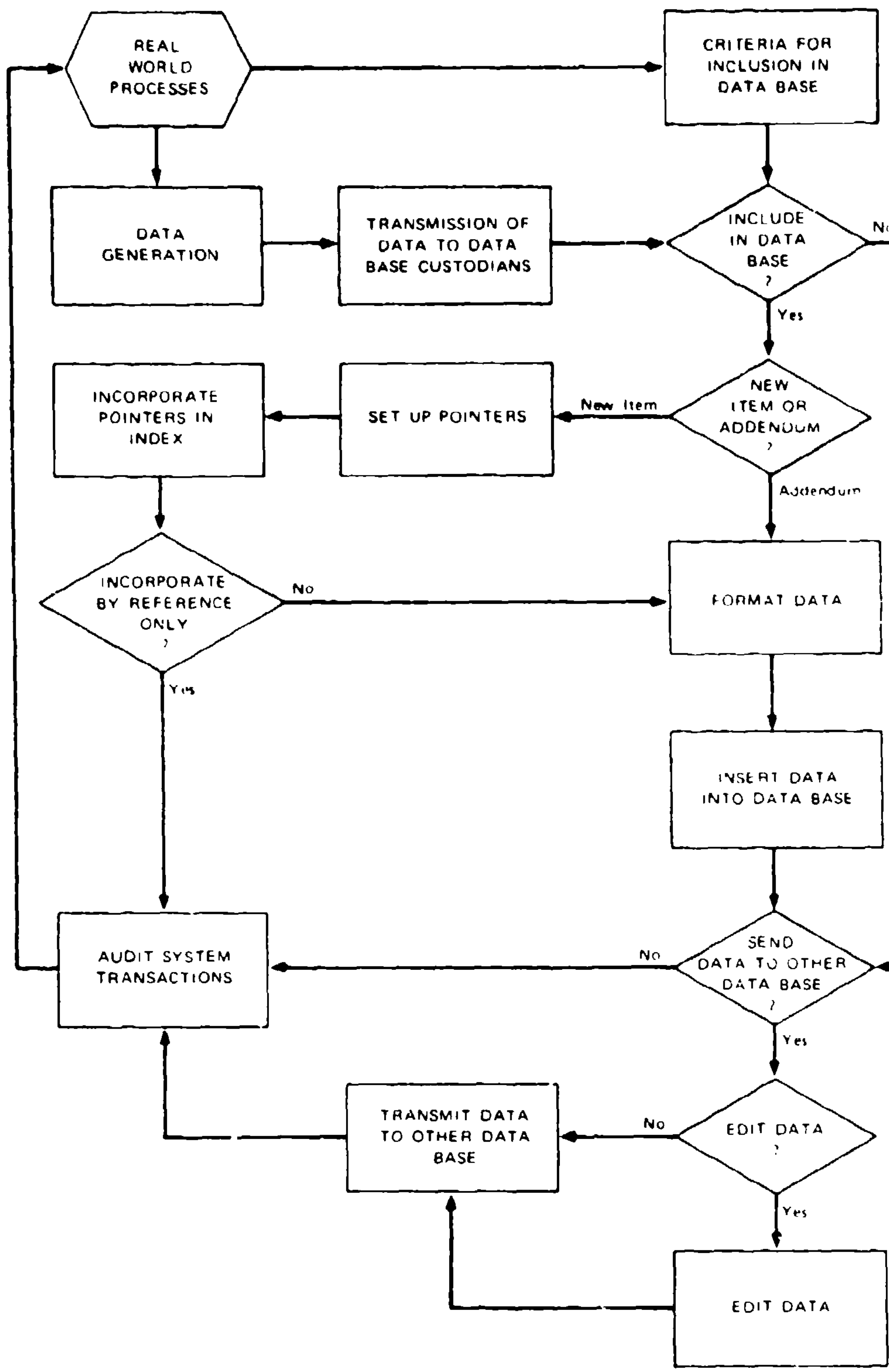


FIGURE 16 DATA COLLECTION AND STORAGE

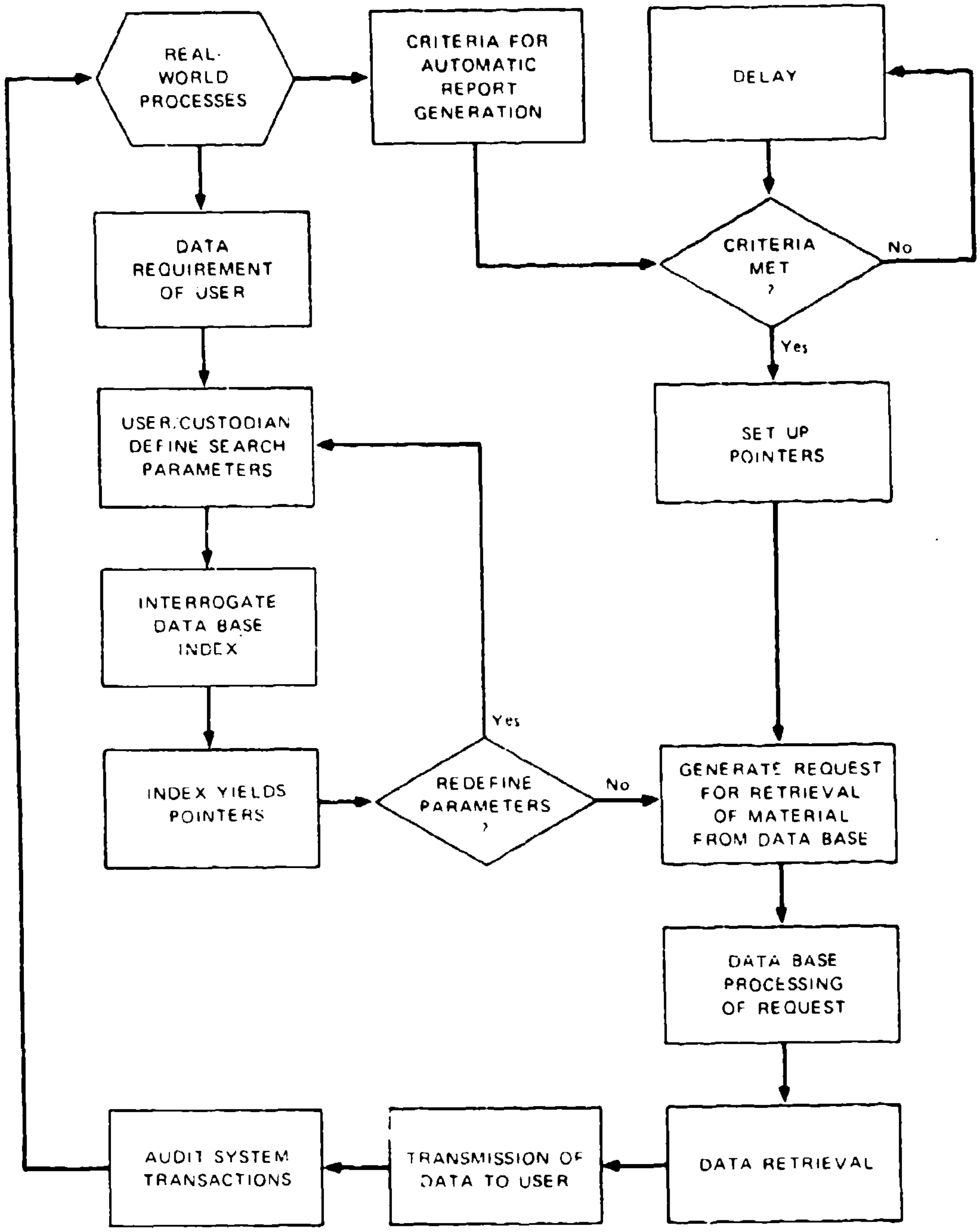


FIGURE 17 DATA RETRIEVAL

Just as the basic functions could be broken out, so may the basic sequential activities. A more detailed breakout of the activities suggested in Figure 17 is shown in Figure 18. At this level, one can begin to identify specific personnel activities. A corresponding breakout of Figure 16 is given in Figure 19.

One way of testing the validity and completeness of these block diagrams is to hypothesize a query or occurrence that would entail the steps outlined and see if the block diagram adequately covers the necessary items. Another approach would be to construct an independent block diagram from the query and then compare the resulting diagram with those constructed from a more generalized approach. SRI did both of these, and three of the resulting example block diagrams are shown in Figures 20, 21, and 22.

As a final diagramming exercise SRI undertook to combine the information learned from constructing the functional block diagrams, the sequential block diagrams, and example block diagrams and began the process of constructing detailed block diagrams that identify not only functions, activities, and personnel, but also specify the logs, forms, and files necessary for proper system operation. Figure 23 represents this effort.

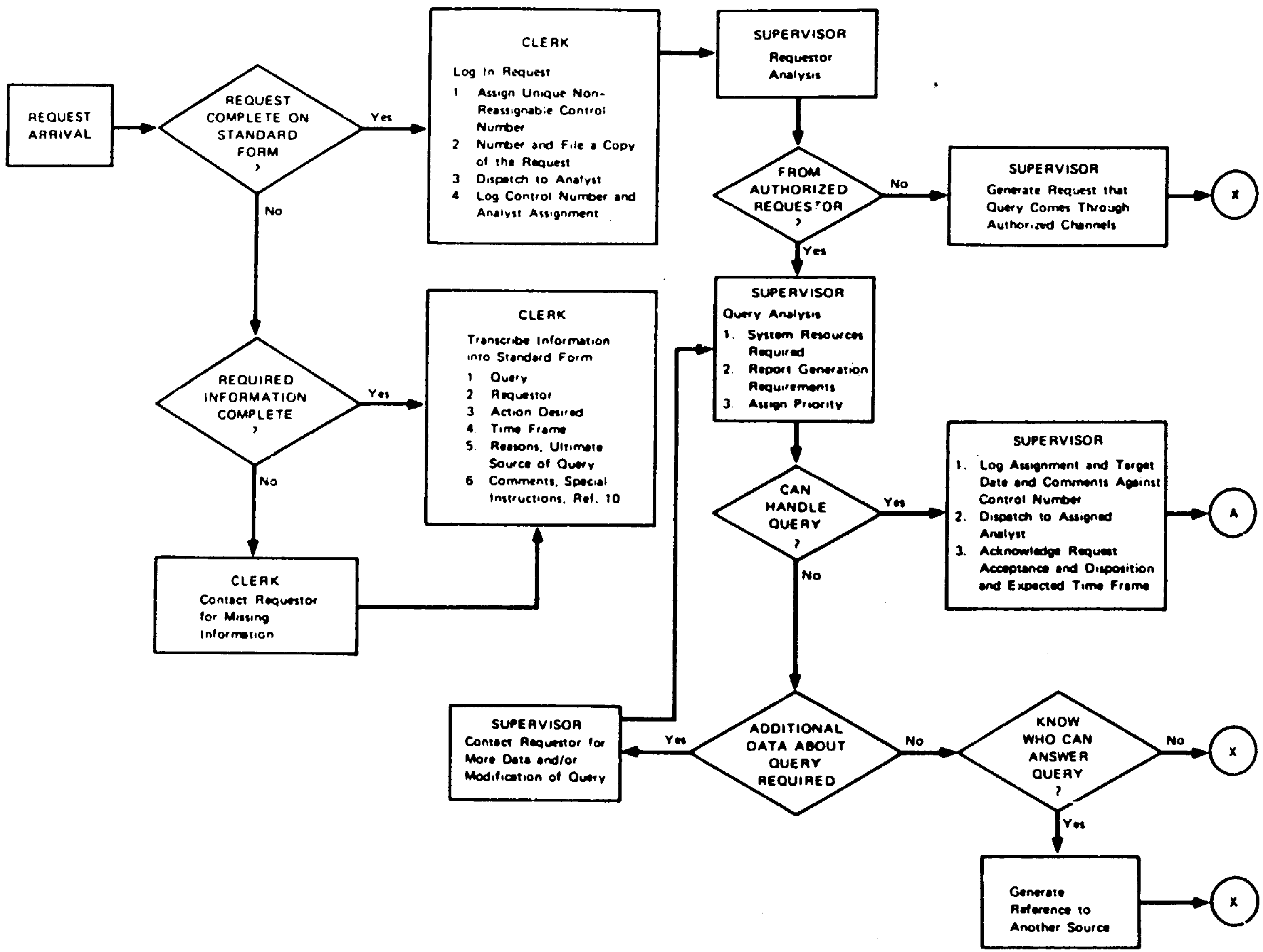


FIGURE 18 REQUEST PROCESSING ACTIVITIES

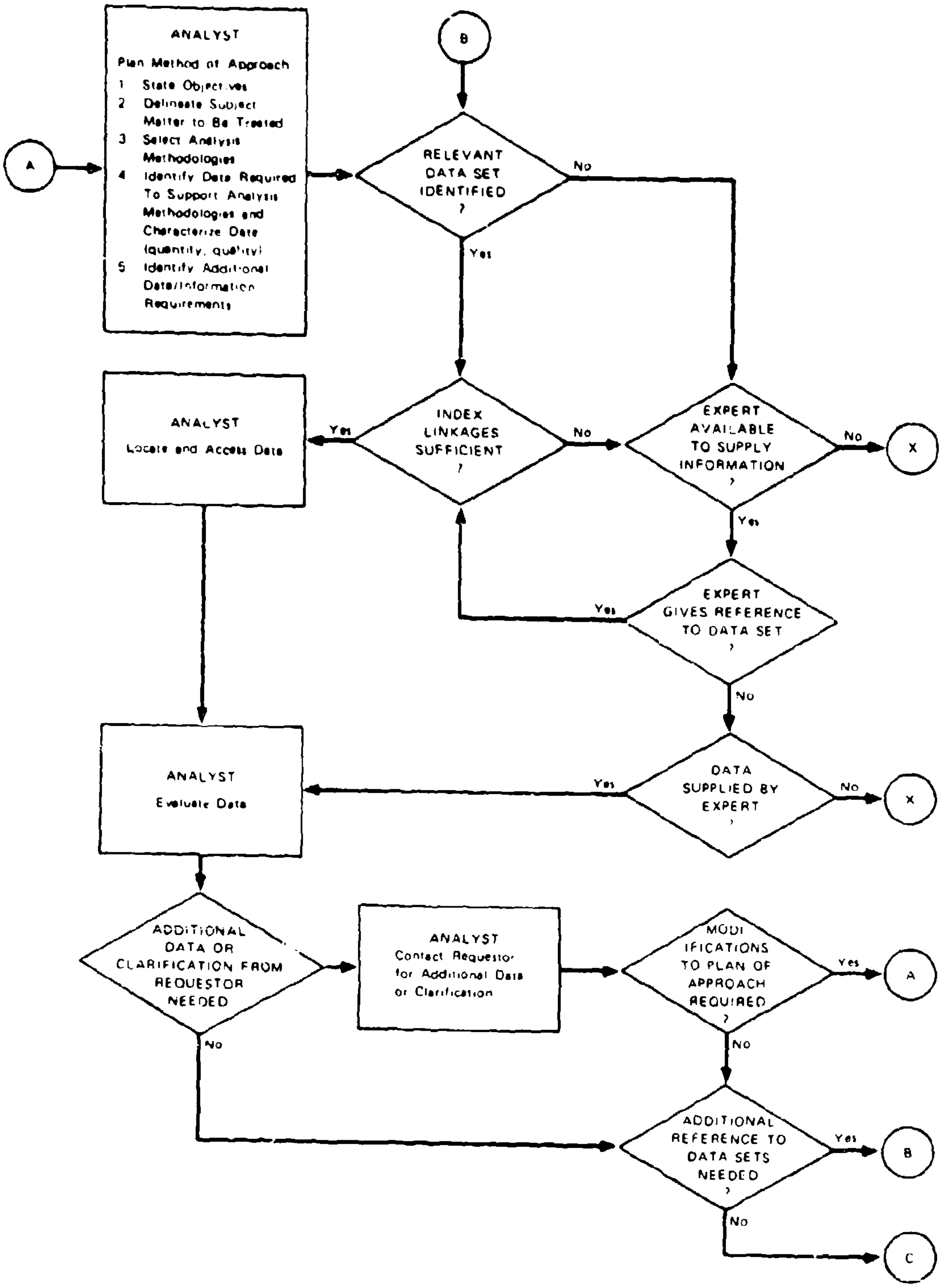


FIGURE 18 REQUEST PROCESSING ACTIVITIES (Continued)

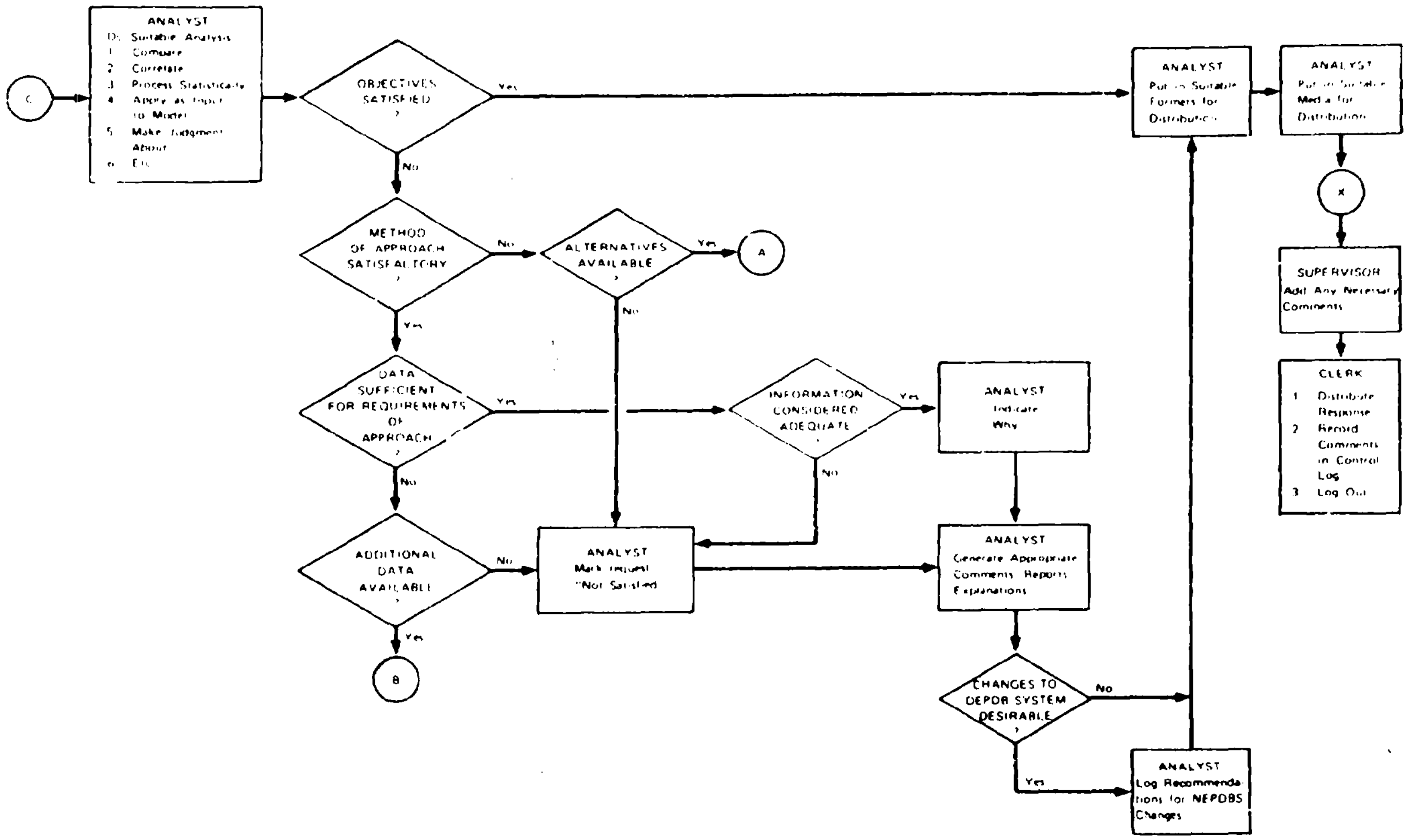


FIGURE 18 REQUEST PROCESSING ACTIVITIES (Concluded)

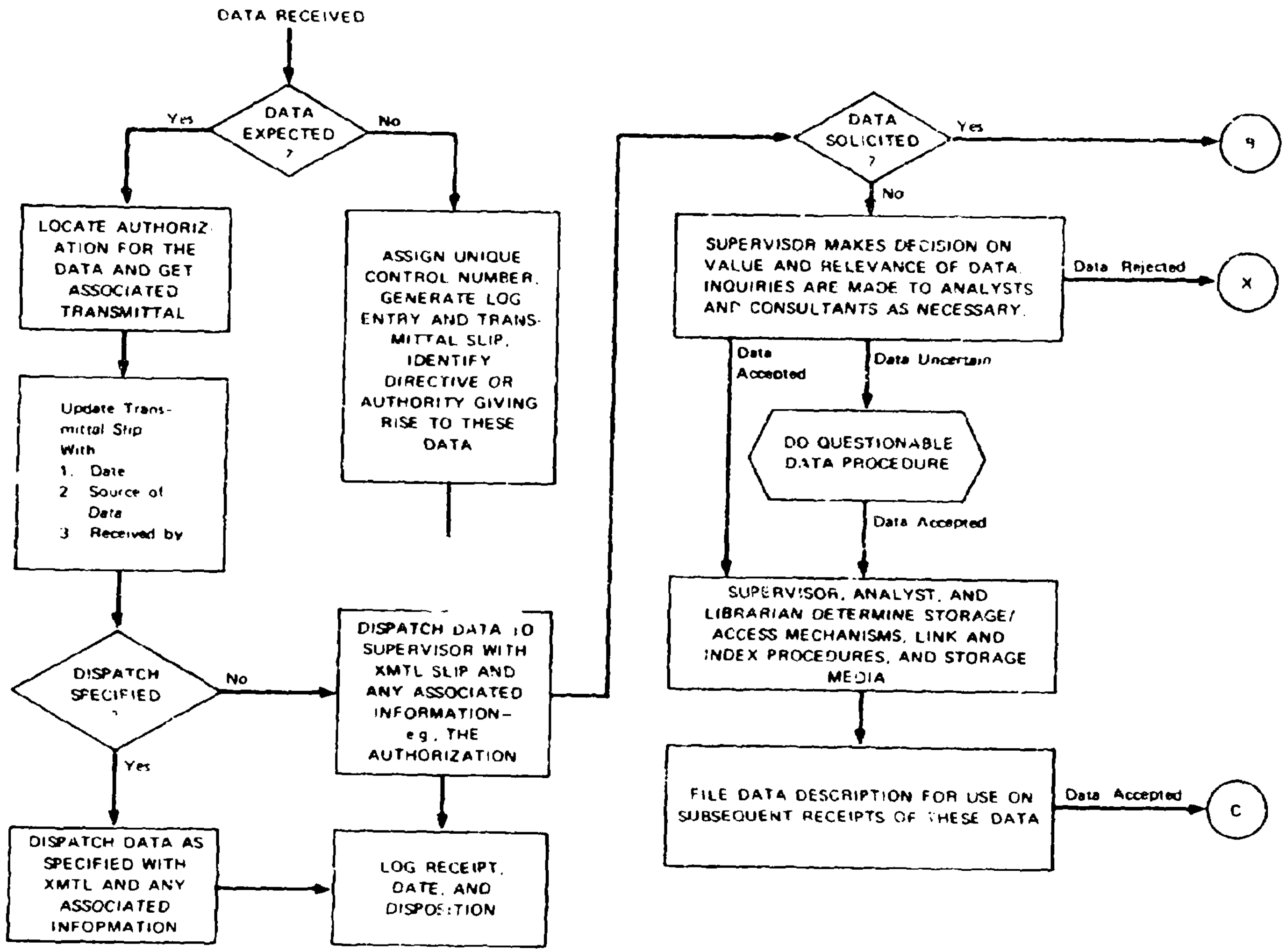


FIGURE 19 DATA PROCESSING

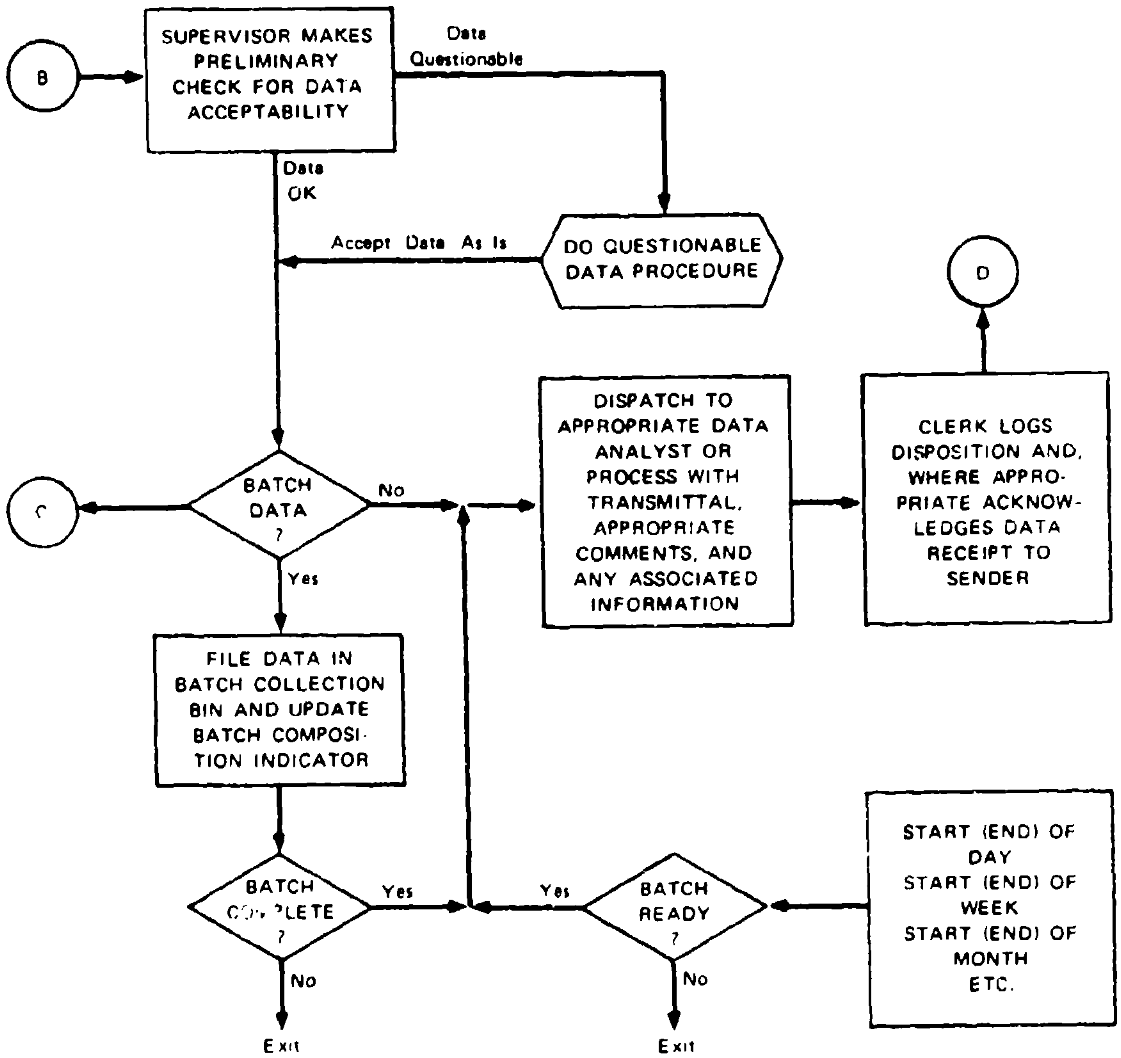


FIGURE 19 DATA PROCESSING (Continued)

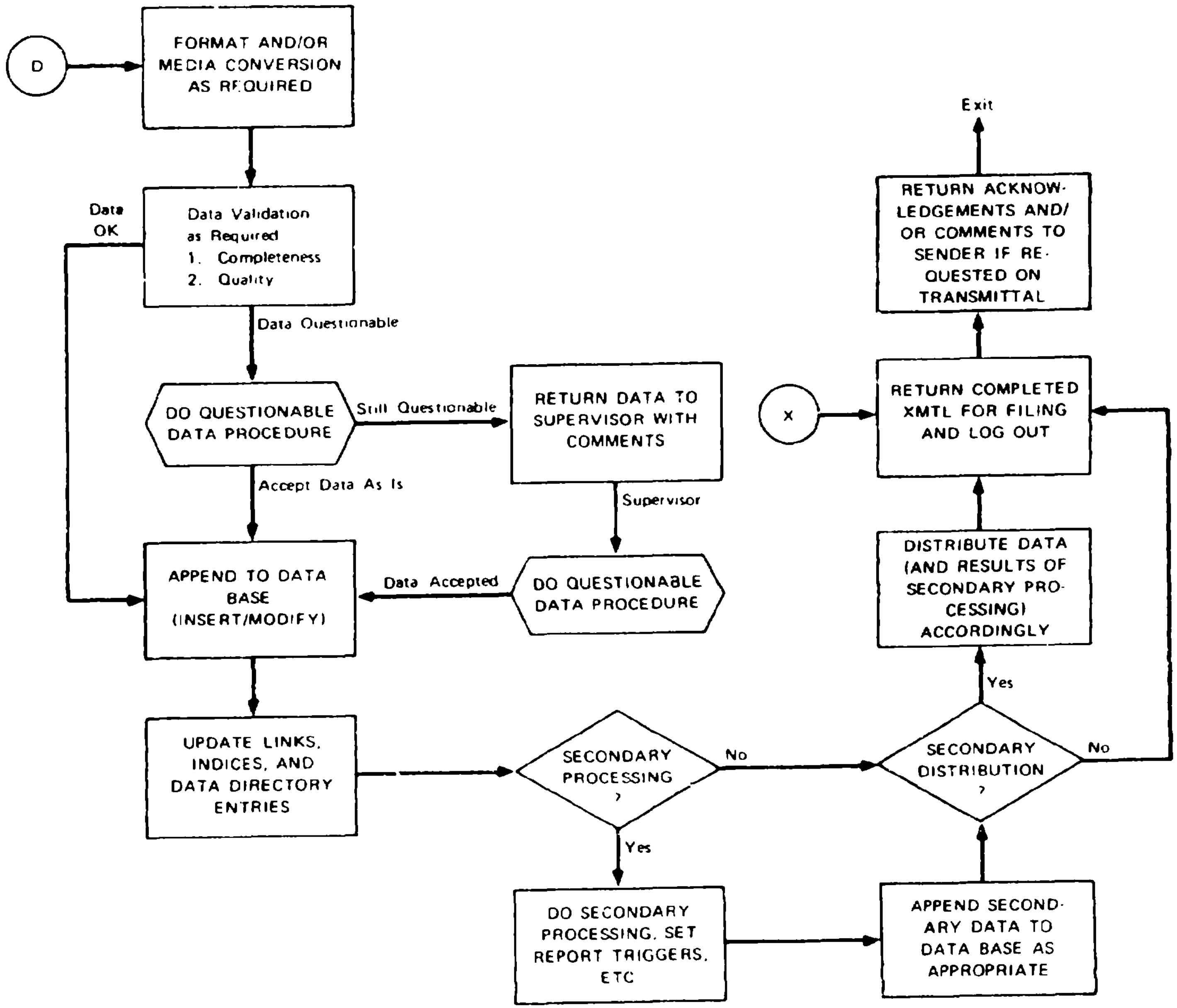


FIGURE 19 DATA PROCESSING (Continued)

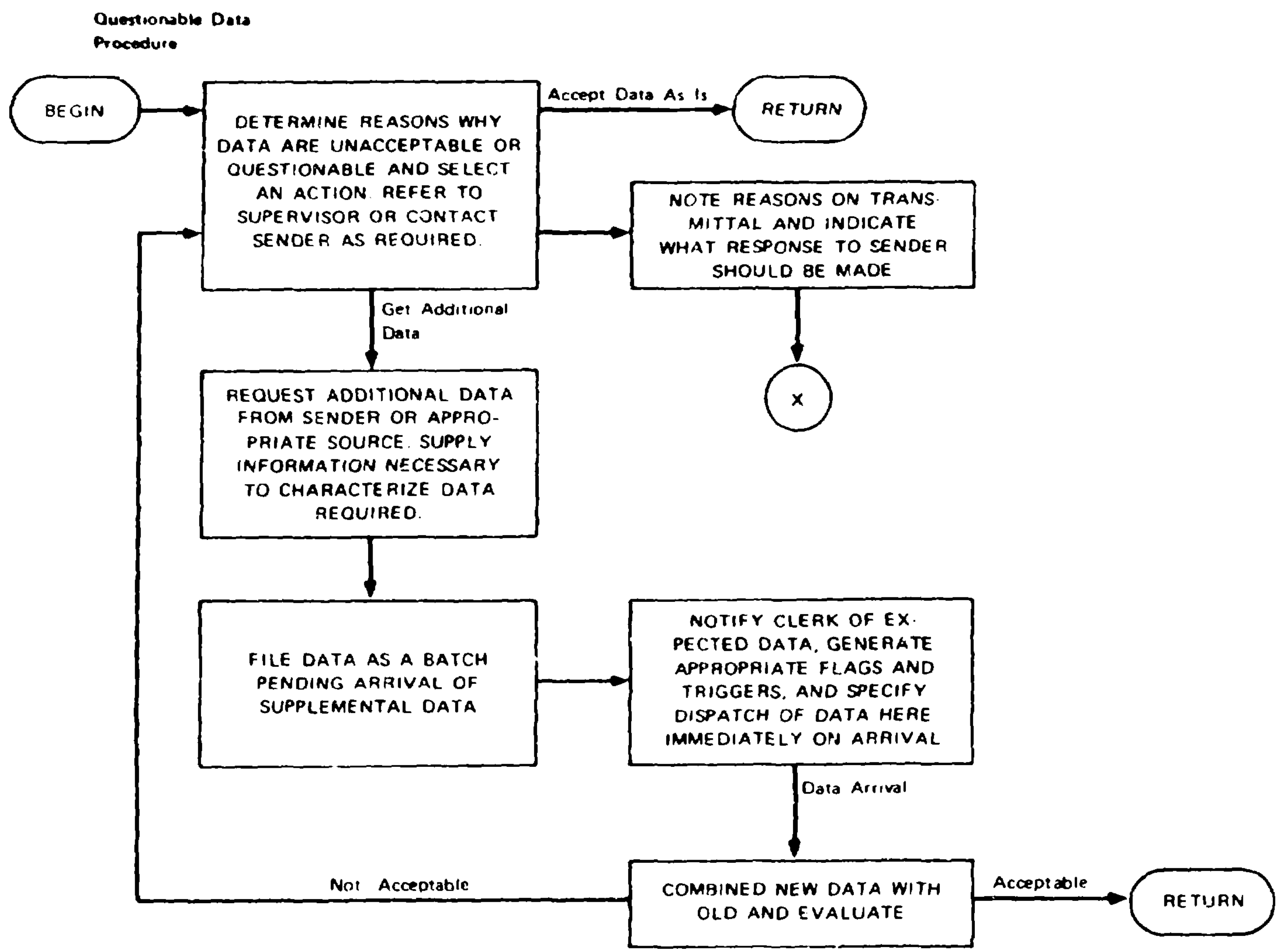


FIGURE 19 DATA PROCESSING (Concluded)

QUESTION: SECNAV wants to know how much oil was spilled last month by the Navy.

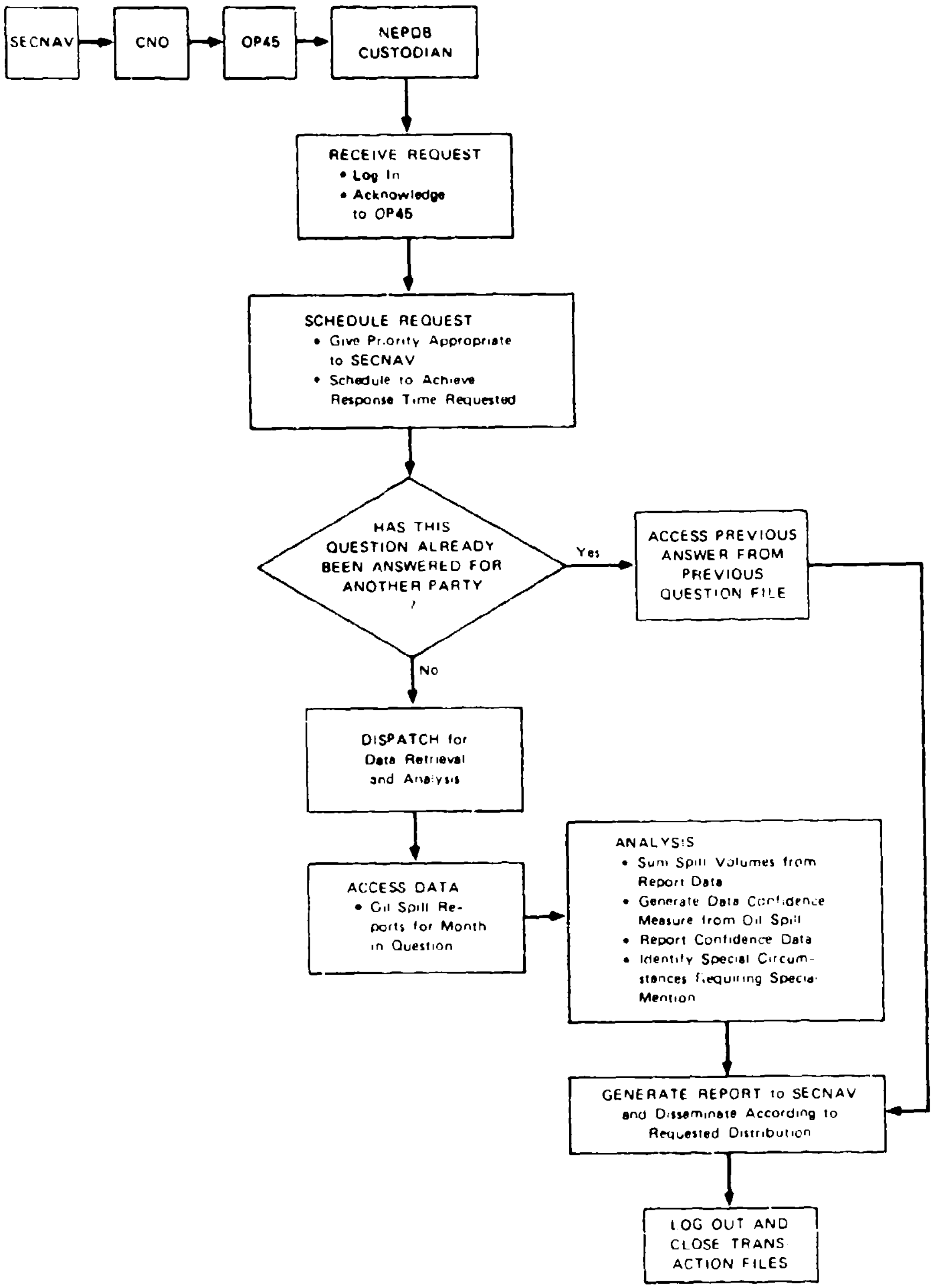


FIGURE 20 OIL SPILL QUERY

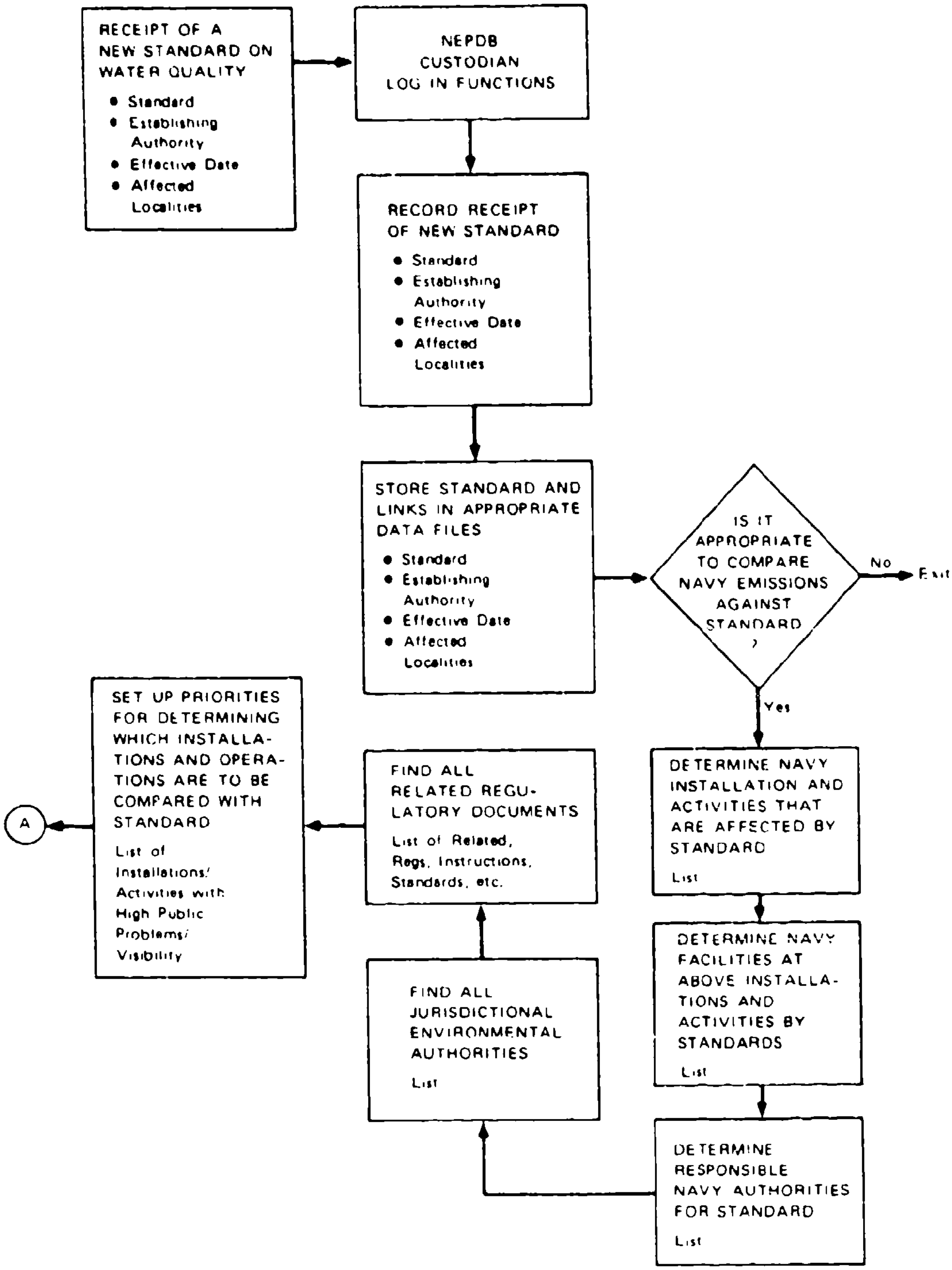


FIGURE 21 RECEIPT OF A NEW STANDARD ON WATER QUALITY

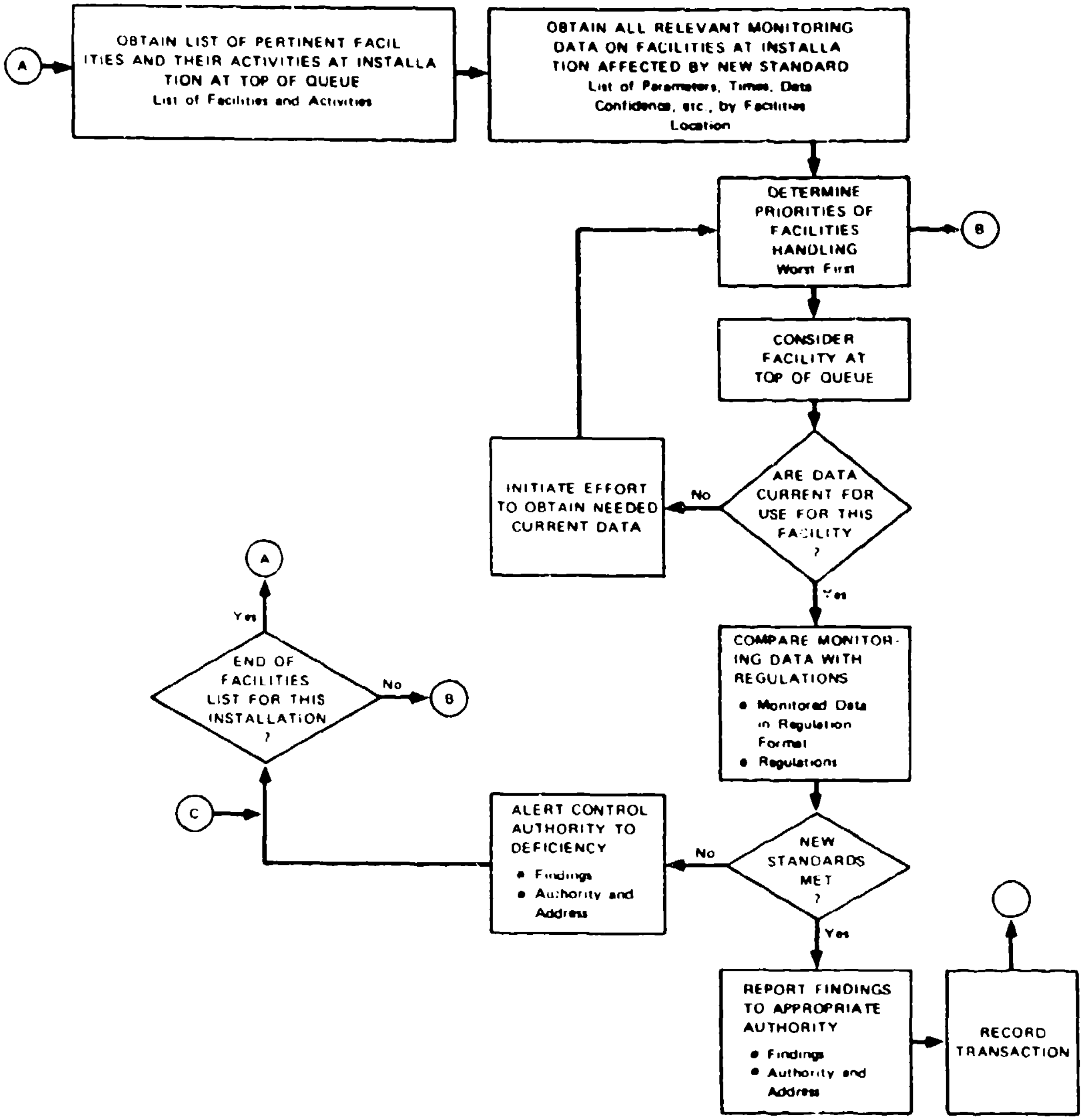


FIGURE 21 RECEIPT OF A NEW STANDARD ON WATER QUALITY (Concluded)

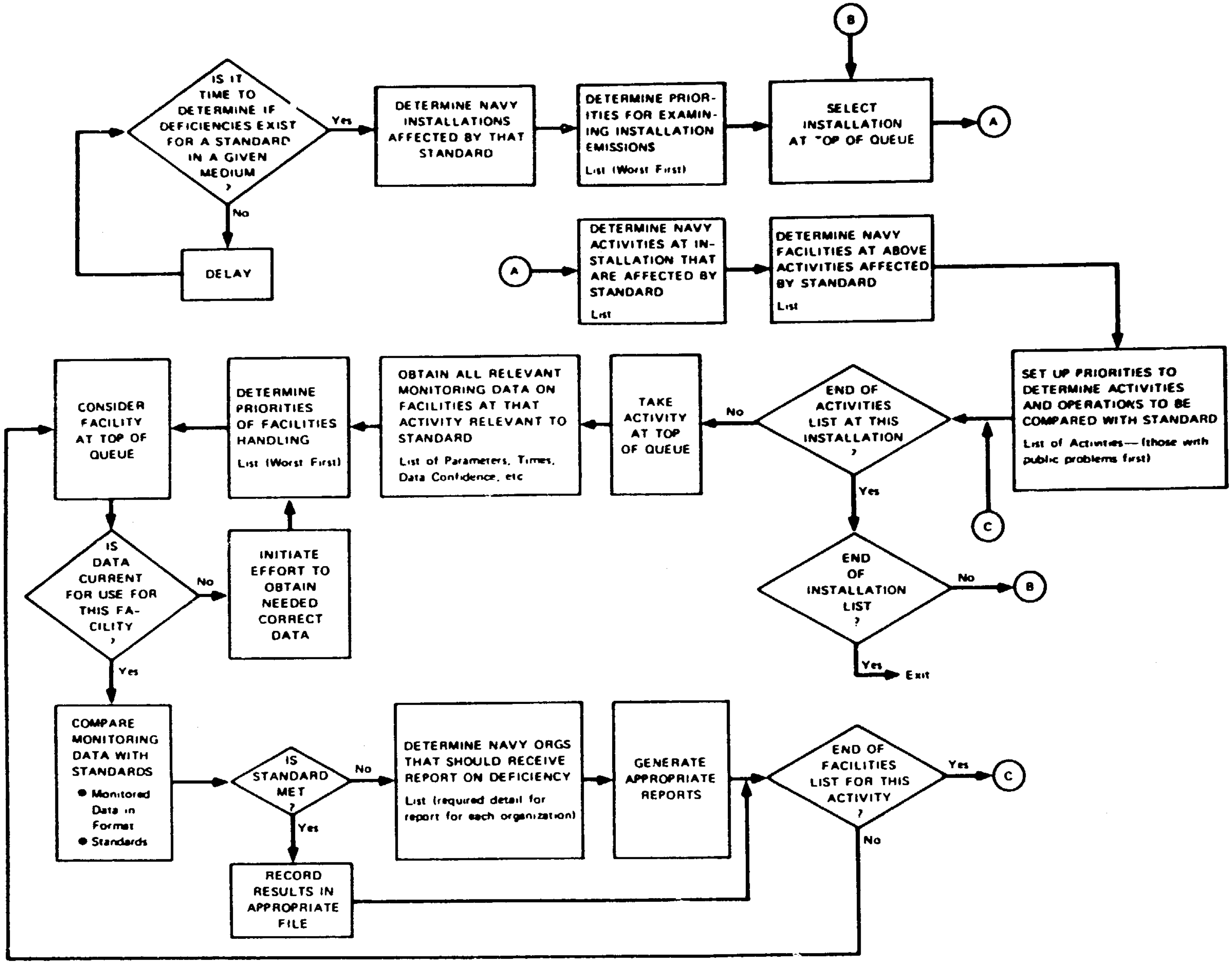
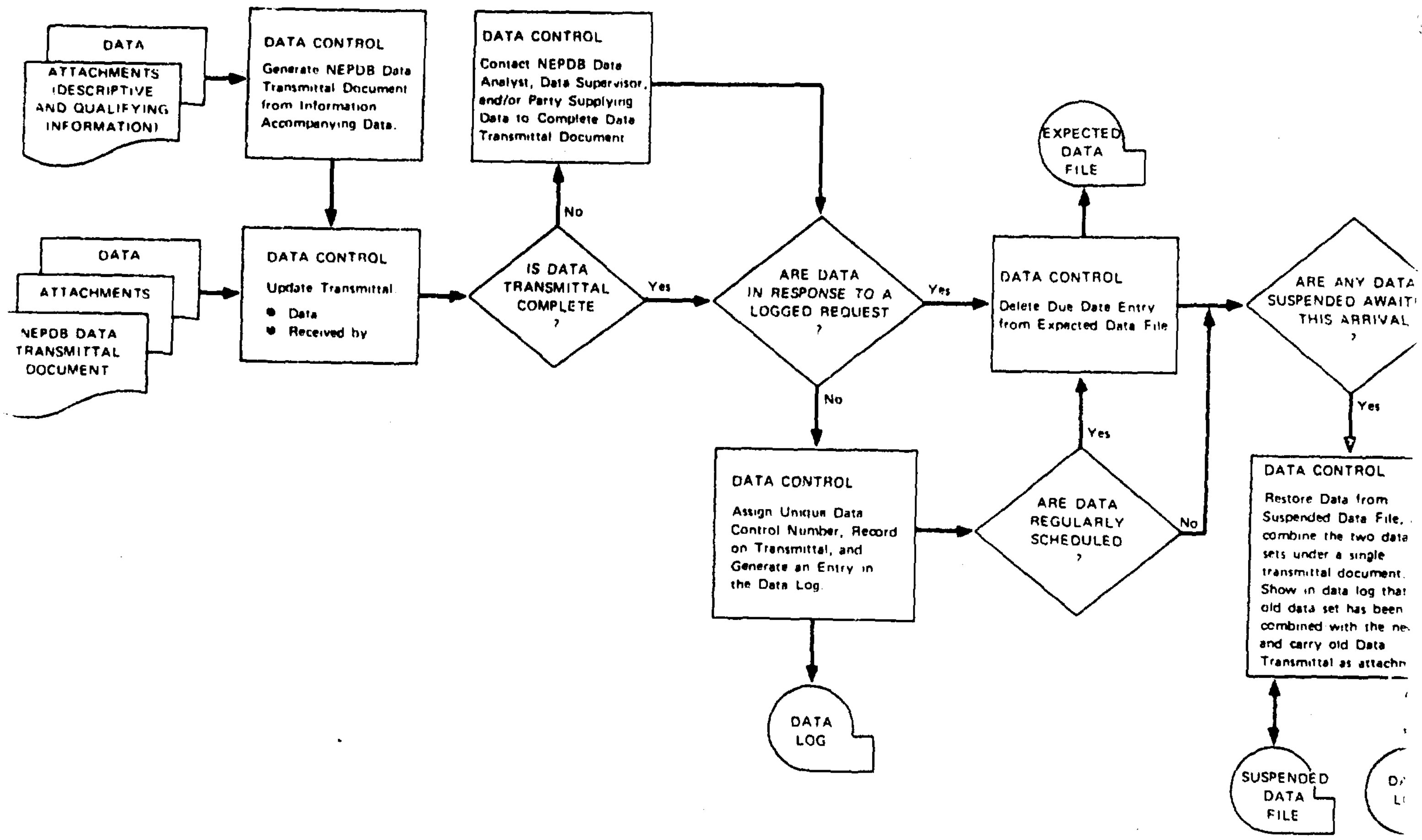


FIGURE 22 SCHEDULED ASSESSMENT OF NAVY INSTALLATION CONFORMANCE TO A STANDARD FOR A GIVEN MEDIUM



DATA
ATTACHMENTS (DESCRIPTIVE AND QUALIFYING INFORMATION)
DATA CONTROL
Generate NEPDB Data Transmittal Document from Information Accompanying Data.
DATA CONTROL
Contact NEPDB Data Analyst, Data Supervisor, and/or Party Supplying Data to Complete Data Transmittal Document
EXPECTED DATA FILE
DATA
ATTACHMENTS
NEPDB DATA TRANSMITTAL DOCUMENT
DATA CONTROL
Update Transmittal
● Data
● Received by
IS DATA TRANSMITTAL COMPLETE ?
No
Yes
ARE DATA IN RESPONSE TO A LOGGED REQUEST ?
Yes
No
DATA CONTROL
Delete Due Date Entry from Expected Data File
ARE ANY DATA SUSPENDED AWAIT THIS ARRIVAL ?
Yes
DATA CONTROL
Assign Unique Data Control Number, Record on Transmittal, and Generate an Entry in the Data Log.
ARE DATA REGULARLY SCHEDULED ?
Yes
No
DATA CONTROL
Restore Data from Suspended Data File, combine the two data sets under a single transmittal document. Show in data log that old data set has been combined with the ne and carry old Data Transmittal as attachn
DATA LOG
SUSPENDED DATA FILE

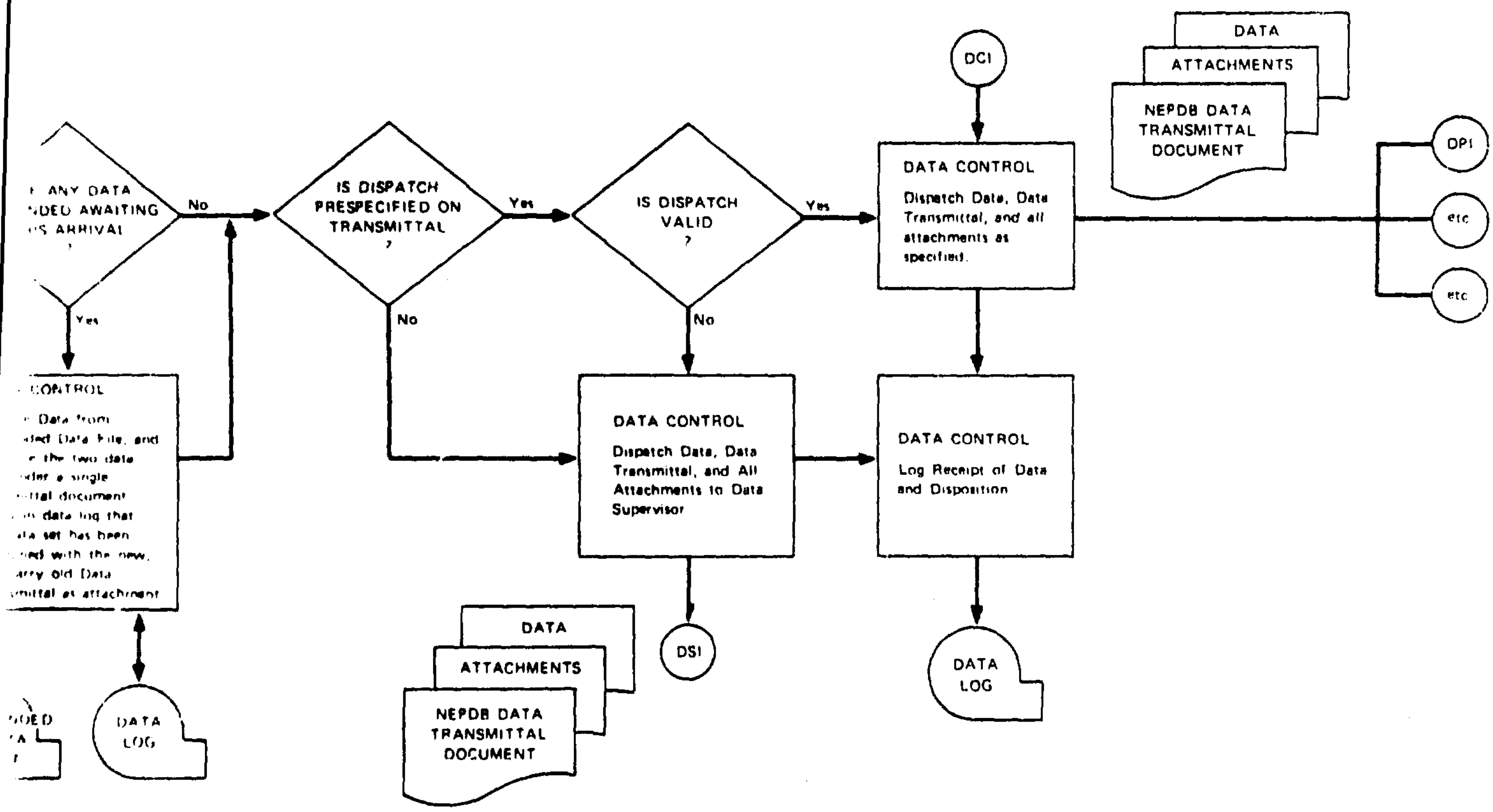


FIGURE 23 RECEPTION AND CONTROL FUNCTION: NEW DATA RECEIPT (LOG-IN) DISPATCHING SUB-FUNCTIONS

In this conceptual study, time did not permit diagramming the whole NEPDB system in this level detail. Nevertheless, this effort provided a strong check on the validity of the conceptual design and a foundation for the detailed design effort proposed herein.

H. Examples of Possible NEPDB Report Output

Three examples of types of reports that might be output from the system are:

(1) Specific Emissions Report

(2) Major Sources of Pollution

(3) Abatement for Major Sources of Pollution.

These report examples are correlated to present considerations at NCEC of records that the NEPDB system might keep. An outline of reports contents is shown below for each report type:

SPECIFIC EMISSION REPORT OUTLINE*

A. Installation

B. Commanding Officer

C. Base Environmental Focal Point (BEFP)

D. Date of This Report

E. Date of Previous Report

F. List of Activities at Installation That Are Currently Emitters of Pollutants

* This report is essentially quantitative and could be assembled at the BEFP level. The same format could be used to answer such questions as "What are the NO_x emissions at Pt. Jones?" or, "What will be the effect of cutting legal emissions by 40 percent?".

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1. List of Emitting Facilities

2. List of Emissions

    a. Quantity of Material Emitted per Unit of Stated Time
    b. Maximum Legal Amount of Emission
    c. Agency Setting Standard
    d. Level of Emission Reported in Previous Report

3. Are Emission Levels Estimated or Monitored?

4. Date of Last Reliable Monitoring of Facility Emissions

5. Number of Identical Facilities in Same Activity

G. Summary of Total Emissions at Installation

1. Total Amount of Material Emitted per Unit of Stated Time
2. Total Quantity Emitted as Reported in Previous Report
3. Percent Difference
4. Total Quantity of Emissions in Excess of Standards

MAJOR SOURCES OF POLLUTION

A. Installation

B. Commanding Officer

C. BEFP

D. Date of This Report

E. Date of Previous Report

F. List of Facilities That Contribute to "Major" Pollution Problems

1. "Parent" Activity
2. Problem Emission(s)
    a. Actual Emission Level
    b. Actual Emission, Previous Report
    c. Legal Limit
    d. Reason Why Considered "Major" Problem*
    e. Emission Control Technology

* Except for items d and e, this report could be generated at the BEFP level.

1) Cost
2) Effectiveness
3) References to Data Base Contents on Subject

ABATEMENT OF MAJOR SOURCES OF POLLUTION*

A. Installation

B. Commanding Officer

C. BEFP

D. Date of This Report

E. Date of Previous Report

F. Date Abatement Program Started

G. List of Facilities Once Considered "Major" Sources of Pollution

1. "Parent" Activity
2. Problem Emission(s)

a. Actual Emission Level
b. Emission Level Before Abatement Program
c. Emission Level, Previous Report
d. Legal Level of Emission
e. Dollars Spent on Abatement Program This Period
f. Dollars Spent Since Abatement Program Began
g. Other Emissions Affected by Abatement Program
h. Abatement Plans for Next Period

1) Estimated Cost
2) Expected Improvement

---

* This report could be prepared at the BEFP level. However, as with the previous examples, aggregated reports covering more than one installation would need to be prepared by Data Base personnel having access to a broader range of data.

X ALTERNATIVE DATA BASE ORGANIZATIONS

A. Conceptual Approaches to Data Base Organization

In making a conceptual design for a data base system, all data elements for which there is a potential demand are identified. For each data element an assessment of cost and value is made. Those data elements whose value to the system justifies their cost are incorporated into the system; those whose value is too low to justify cost are excluded. Value may be expressed in terms of the demands on the system that the presence of the data element allows to be satisfied. Cost, however, is composed of both direct and indirect factors and is more difficult to assess.

Certain data elements are required to satisfy each demand on the data base system. By selecting a set of anticipated demands to which the system will respond, the data base content is implied A direct cost for collection may be associated with each data element. Thus, specification of data base content determines the greater part (but not all) of the system cost for direct collection of data, both initially during system implementation and thereafter on a continuing basis.

It is not sufficient, however, merely to specify the contents of the data base; data must be organized if access and maintenance are to be systematic and effective. The implementation and maintenance of this organization introduce a second set of costs above and beyond direct data

collection costs. With each data element both a direct collection cost and an indirect, organizational overhead cost must be associated.

Consider the case of a library. The data base consists of books and publications. In specifying the scope of the library, its contents are largely determined and the requirements and costs for acquisition and maintenance of these contents can be established. It is then necessary to impose an organization on these contents. For purposes of discussion the organization will be considered to consist of three components:

(1) Logical structure. Each data element is assigned a unique identifier. This identifier may carry information about the data element (like the Dewey Decimal System for classification) or simply be a unique, sequentially assigned accession number.

(2) Physical organization. A filing and storage mechanism is established to implement the logical structure. The identifier assigned to a data element serves as an index by means of which that data element may be directly located within the physical organization.

(3) User interface. Means are established by which a user's characterization of his requirements may be mapped onto the logical structure of the data base. In a library this interface takes the form of catalogs in either card or book form. The user characterizes his requirements in terms of author names, book titles, or subject headings and uses the catalogs to map these characterizations into indices (the unique identifiers) by means of which the appropriate data elements are located within the physical organization of the library.

The mapping of the user's characterization of his requirements onto the data base logical structure and the mechanisms by which the data elements are indexed and accessed determine the speed and flexibility with which the data base system can respond to user demands. The logical structuring

and physical organization are largely technical design problems. The user interface has both technical and human factor considerations and generally entails evaluation of more alternatives. To a large extent the utility of the data base system is determined by the quality of this interface.

The library catalog system is an excellent example of a user interface to a data base system and illustrates a number of important points:

(1) The three library catalogs--author, title, and subject--in effect constitute three different dimensions from which the data base may be indexed. Such multiple-dimensional indexing provides additional degrees of freedom to the user. Each of the catalogs, in effect, describes a different logical structure and ordering of the data base to the user. That is, the user "sees" the data base through the organization of the catalog. It is in this sense that the catalog constitutes an interface between the user and the data base and a means of mapping the user characterization of his requirements onto the data base logical structure. It is therefore most critical that the "dimensions" through which the user sees the interface correspond to those by means of which he characterizes his requirements.

(2) The catalogs are not simple orderings. The author and title catalogs contain many cross references to account for title and name inversions, alternate spellings, and popular versus accepted spellings. Provisions must be made for transliterations of foreign languages. The subject catalogs are hierarchical with many cross references and "see also" citations. Multiple references to a single data element under different subject headings are common.

(3) The catalog entries contain considerable information about the data element in addition to citing a data element identification index. In many cases the user requirement can be satisfied by reference to the catalog alone without access to the data base. How much and what information should be included in a catalog entry are important design trade-offs and influence both the cost and utility of the overall data base system. This constitutes a distribution of the data base to enhance utility.

(4) There are implementation and maintenance costs associated with cataloging and data base maintenance that must be traded off against utility and value. For example, when a data element is removed from the library, it is necessary to delete references to that element from each catalog. To facilitate this operation, the main catalog entry--either author or title--generally indicates subject headings and alternate spellings and cross references under which references to the data element are made, so that all references can readily be located without exhaustive searching or guess work. These in effect constitute cross-referencing or backward links that are necessary for effective and efficient user interface maintenance procedures

These considerations, drawn from the library example, constitute design factors and trade-offs to be used in selecting an organization for the NEPDB system.

Some of the alternatives (and associated costs) are best illustrated by example. Consider the following user question: What standards govern pollutant X at location Y? The data elements to be accessed are one or more environmental standards. The basic method of locating the required data elements is to scan all available standards to locate those with jurisdiction over location Y and governing pollutant X. If there are M locations, each having N standards, a total of $M \cdot N$ standards will have to be scanned to satisfy the demand on the data base. This approach is feasible only if $M \cdot N$ is small and access to this group of data elements is infrequent. Organization is rather simple, requiring only that all data elements in this category be located in the same file and that the user can be directed to this file when appropriate.

Several methods exist for enhancing accessibility to the required data elements, all requiring that the question be broken into elemental

components. The user may ask: What standards apply at location Y? and What standards govern pollutant X? The demand on the data base is then satisfied by identifying and accessing those standards that satisfy both questions. This implies the existence of catalogs: one that is indexed by location and yields (identifiers for) standards having jurisdiction at each location; one that is accessed by pollutant and yields (identifiers for) governing standards; and/or one that is accessed by standard (or standard identifier) and yields either locations affected or pollutants controlled or both. (The last catalog constitutes a summary or abstract of the standards themselves in a uniform format suitable for catalog and indexing purposes.) Having one or more of these catalogs, the original user question can be satisfied in any of several ways:

(1) The location catalog can be indexed to location Y, yielding (identifiers for) all standards that apply at that location. Next, the standards catalog can be indexed to each of these standards to determine which apply to pollutant X.

(2) The location catalog can be indexed to location Y, yielding (identifiers for) all standards that apply at that location. Next, the standards themselves can be accessed from the data base to determine which apply to pollutant X.

(3) The pollutant catalog can be indexed to pollutant X, yielding (identifiers for) all standards that apply to that pollutant. Next, the standards catalog can be indexed to each of these standards to determine which apply at location Y.

(4) The pollutant catalog can be indexed to pollutant X, yielding (identifiers for) all standards that apply to that pollutant. Next, the standards themselves can be accessed from the data base to determine which apply at location Y.

(5) The location catalog can be indexed to location Y, yielding (identifiers for) all standards that apply at that location. Next, the pollutant catalog can be indexed to pollutant X to

yield (identifiers for) all standards exercising control over that pollutant. Comparing the two lists will identify all standards that affect both pollutant X and location Y.

One method will be preferable, depending on the ease of indexing the various catalogs and the number of items listed under each catalog entry.

(What may appear initially to be a simpler method has not been listed--that is, to call someone at location Y and find out directly what standards apply to pollutant X. This approach may well be best in many instances. However, several considerations apply:

(1) The need for catalogs is not eliminated. A catalog or directory indexed by location and giving the name and telephone number of the person to contact is required. There may be several such contacts at each location, depending on the nature of the query.

(2) The contact himself must have a catalog or directory of standards applicable to his location, sufficient at least for him to describe standards by their data base identifiers.

(3) If the contact is not able to describe standards by their data base identifiers, someone else must map his description of the standards onto the data base identifiers to allow access to the data base or further indexing within the system, and this in turn requires a catalog or directory.

This method, then, does not necessarily reduce effort or eliminate the need for directories and/or catalogs. It simply displaces effort and changes the kinds of information required from catalogs and directories.)

In the examples above, by breaking the question into elemental components and using catalogs, the searching has been reduced from an $M \cdot N$ search to at most an $M + N$ search. If the catalogs can indeed be directly indexed to pollutant or location, the search is reduced to an

M or an N item search, depending on which catalog is accessed. The generation and maintenance of these catalogs, directories, cross-reference links and the like, impose demands on the resources available to the data base system. These resource demands are justified to the extent that corresponding reductions in resources required to access and maintain the data base itself are realized.

The basic justifications for and approaches to the data base organization having been described, the methods and trade-offs can be applied to the NEPDB system. Particular attention will be given to the points identified in the library example, and use will again be made of the user question commonality matrix.

B. Indexing Dimensions

The information necessary to arrive at a conceptual design for one or more data base organizations began with the analysis of Navy requirements and the user questions that might arise in efforts to satisfy these requirements. Because of the large number of questions that could be formulated for each requirement, commonalities and methods for grouping and categorization were sought.

It was quickly recognized that a question could be described by two attributes:

(1) The data element(s) whose access is the target of the question

(2) The dimension(s) by which the question addresses the data base.

In the preceding section the question used as an example was: What

are the standards governing pollutant X at location Y? The target of this question is a set of one or more standards to be accessed from the data base. The data base is addressed through the dimensions of location and pollutant. Table 21 illustrates other dimensions through which this basic question might be asked of the data base: What are the standards?

This process was carried out for each of the basic requirements and the associated questions; it yielded sets of candidate data base indices or entry dimensions, one for each candidate data category (e.g., standards). Again, the Environmental Effects Framework provided a means by which these groupings could be checked for completeness. The refined list contained 12 dimensions by which one or more of the data categories might be indexed:

(1) By Pollution and Environmental Control Authority.

(2) By Pollution and Environmental Control Standard.

(3) By Geopolitical Location, e.g., city, state, region, and so on.

(4) By Naval organization, e.g., NAVFAC, BUMED, and so on.

(5) By Naval location, e.g., district, complex, installation, and so on.

(6) By facility type, e.g., a class of ships, a boiler, a plating shop, and so on.

(7) By materials and supplies.

(8) By environmental parameters/constituents and plant effluents.

(9) By data sets describing parameter monitoring.

(10) By Naval instruction and/or directive.

(11) By environmental monitoring and instrumentation technique.

(12) By control and abatement technique.

Table 21

DIMENSIONS THROUGH WHICH STANDARDS MIGHT BE ACCESSED

Requirement
Ascertain that standards are met
Basic query
What are the standards?
Dimensions
1. By location At a specific Naval installation or activity Within a Naval District, and so forth Within the jurisdiction of a particular pollution control authority Within a particular geographical area, e.g., the San Francisco Bay Area, the Los Angeles basin, the City of Oakland, and others
2. By organization For those activities within the scope of a particular Naval organizational entity For a particular pollution control authority
3. By activity and/or facility For a specific activity, e.g., sand blasting For a class of activities, e.g., the manufacture and assembly of munitions For specific facilities whose operation constitutes a source of pollutants, e.g., cyclone separators, a particular jet aircraft, and the like
4. By pollutant (system output) For a specific pollutant For a class of pollutants, e.g., air, noise, and so on
5. By materials (system input) For specific materials whose use gives rise to pollutants For specific materials whose presence constitutes a potential hazard

For each of these dimensions a catalog or directory might be produced, producing a means for accessing the data base or other catalogs from that dimension.

The idea of catalogs accessing other catalogs or directories is not new. In identifying potential user questions it became obvious that many questions would require multiple levels of indexing or mapping before final access to the desired data was achieved. For example, in attempting to determine the consequences of a new standard at a particular location, it would be necessary to determine first what facilities were present at that location, then determine what effluents and residues resulted from operation of those facilities, then to apply the new standard, and finally access information about monitoring and control techniques where abatement was required. More complicated examples could be constructed. The conclusion was that catalogs would have to contain both direct indices to the data base and indirect references through other catalogs and directories to satisfy more complicated, multifaceted questions.

The next step was to postulate basic questions that might be asked by a user accessing the data base through each of the candidate dimensions. A preliminary commonality matrix, similar to that shown in Section VIII, was then prepared. An attempt was made to identify alternate entry points and basic question sequences for each user question. Basic questions for which there was no apparent demand or use were eliminated. New basic

questions were added. This preliminary matrix is not shown because of its size and because its intent was merely to refine the working candidates into a feasible and realistic set. The basic questions remaining after this step are those shown in the commonality matrix of Section VIII and listed in Table 13. Only 10 dimensions are shown in Table 13. Dimension 10 is not included and dimensions 11 and 12 are combined.

Also at this point, a map of linkages between the different dimensions was drawn, as shown in Figure 24. To draw this map it was postulated that for each dimension there existed a file or other assembly of data and information sufficient to answer each of the basic questions for that dimension and accessible directly by an index to that dimension. For example, the information about pollution and environmental control authorities might be put into a card catalog. Identification of a particular authority would be sufficient to locate directly the appropriate card in the file. The card would contain data and information sufficient to answer all basic questions identified for that category. Many of the basic questions can serve either to supply a direct answer or to indicate access to data through other dimensions. Such basic questions (actually the data necessary to answer them) effectively generate linkages between the dimensions, and this is the basis for the linkage map.

The commonality matrix shown in Section VIII and the linkage map of Figure 24 together served as the basis for establishing both the data base content and the data base organization selected for use in the final

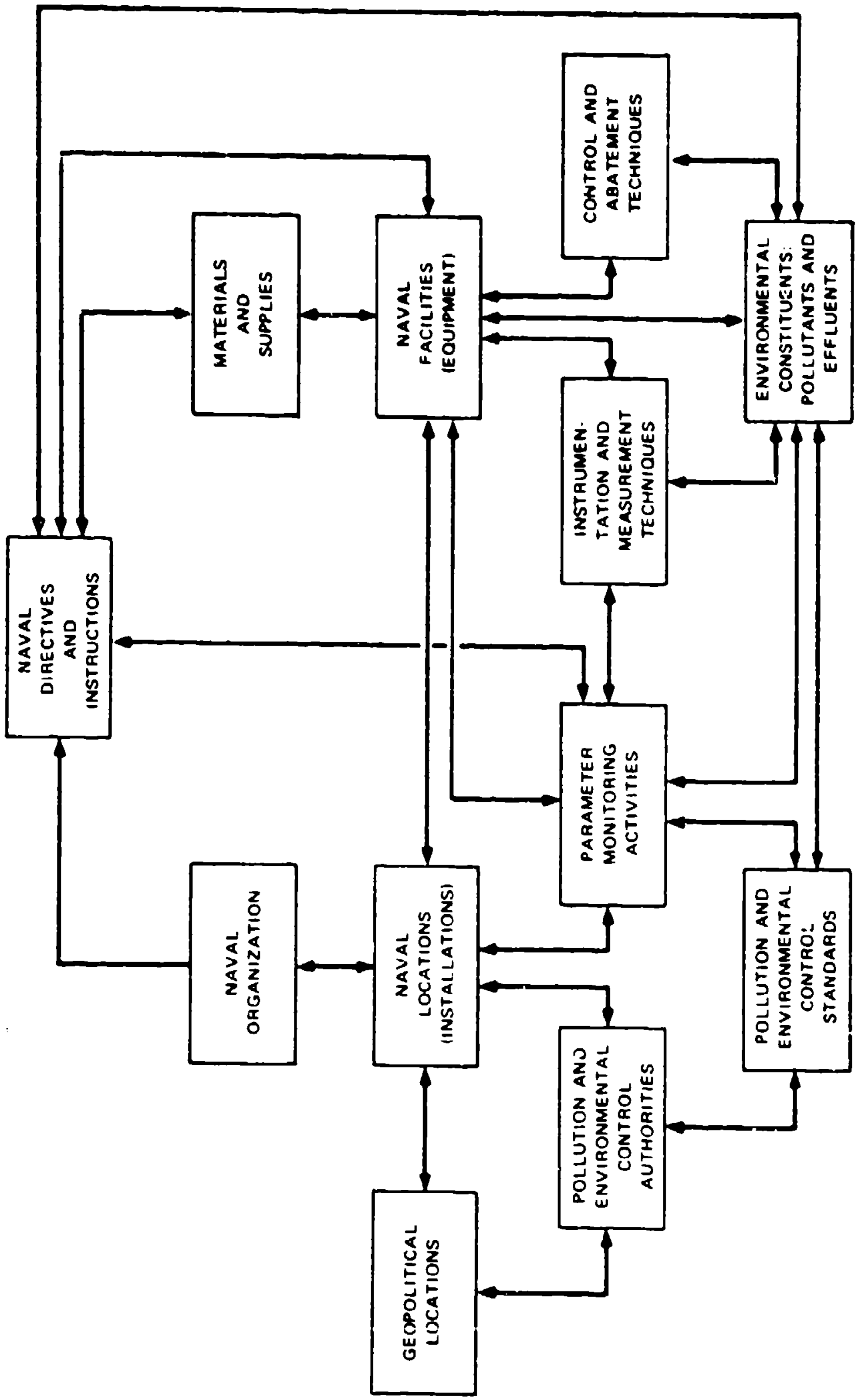


FIGURE 24 PRELIMINARY DATA LINKAGE MAP

trade-off analysis and system definition. A revised linkage map is shown in Figure 25. It is suggested that for each dimension there be a catalog, directory, or file of data and information, as described above. Table 15 indicates the files, the dimension or key by which the file is indexed for data access, and the basic data elements to be associated with each entry. Figure 25 and Table 15 thus constitute the last refinement of the data base content and organization for the conceptual design stage. During a detailed design the contents and organization will require a more precise definition, and it is expected that this will bring about further changes and refinements in content and organization.

Two new data categories appear both in Table 15 and Figure 25. These categories--Complaints and Previous Questions--are to satisfy requirements that do not appear directly in the set of anticipated user questions. In particular, it is expected that flexible access to response made to previous questions can result in considerable overall system savings once operation has been underway for a sufficient time to build up a backlog of such responses. To date, no entirely suitable method has been established for accessing these files, particularly the previous questions. Both result from the logging out function, when the system has completed its response to a demand. However, better methods than access through the system logs will be required if full use of the information contained in these files is to be made. Tentatively, indices to the complaint file are shown as basic data elements in the Naval Location and Facilities categories.

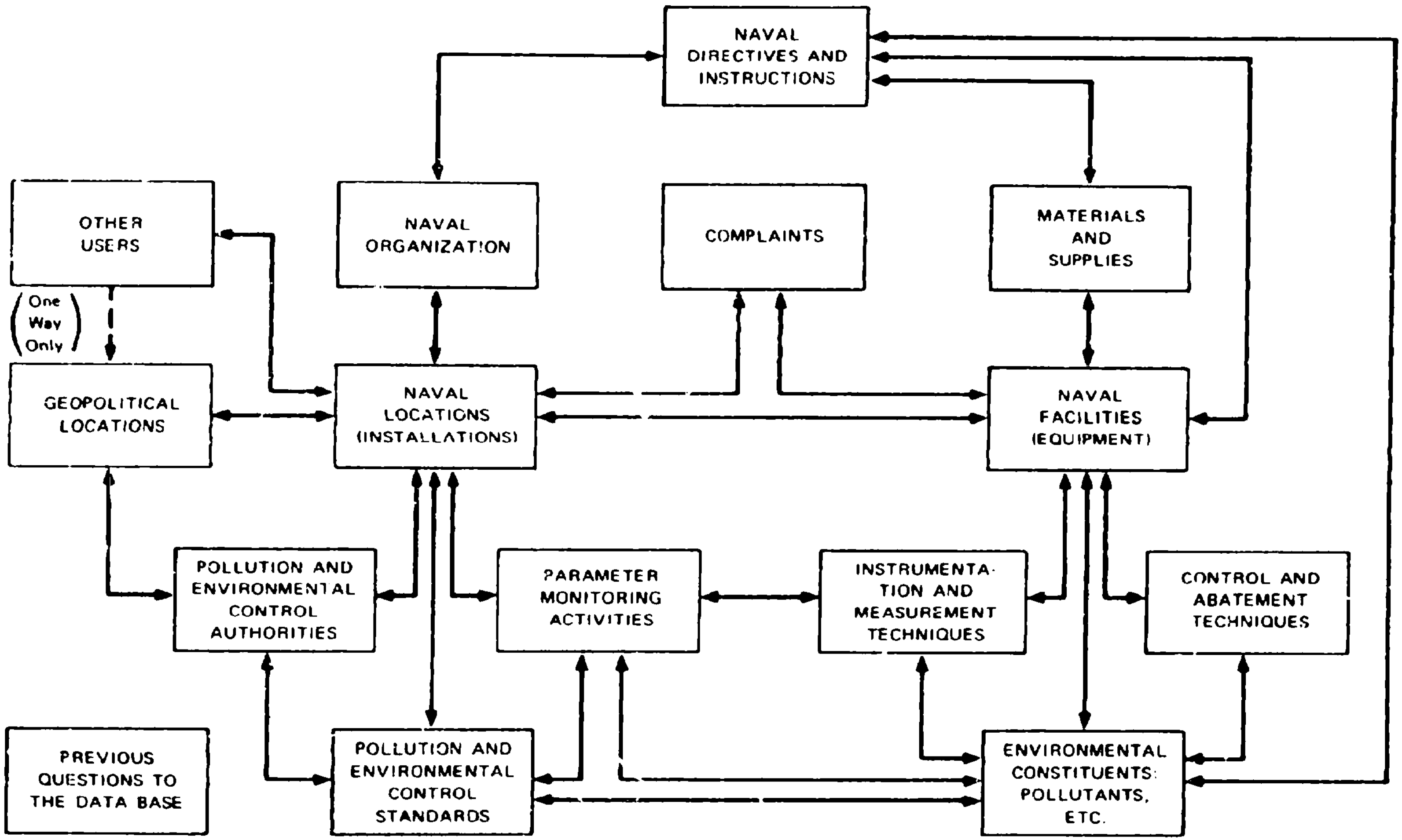


FIGURE 25 FINAL DATA LINKAGE MAP

Note that an additional data category--Other Users--is shown only in Figure 25. The purpose of these data is to identify non-Naval entities that either compete with the Navy for use of the receiving media or that can supply services to the Navy for the purpose of waste treatment, disposal, or control. The utility of such a category has not been firmly established, but it is included for completeness and to indicate how it will be linked logically to other data dimensions and categories.

Because of the large number of basic data elements, no attempt will be made to trace the evolution from the initial exhaustive listing to the final set established for the conceptual design. There are one or two interesting observations, however. In Figure 24 access to standards from Naval locations is through the Inventory of Pollution and Environmental Control Authorities. The commonality matrix showed, however, that this two-step path was taken so often that direct access would be more desirable. This is reflected in Figure 25.

It is not yet clear whether separate files and dimensions should be established for monitoring and instrumentation techniques on the one hand and control and abatement techniques on the other. With the exception of the access key itself, the basic data elements are the same for the two categories, and they could conceivably be merged into a single category.

A number of basic data elements in Table 15 are not shown in the commonality matrix or other listings. These are elements for which a need was detected during the construction of the second commonality matrix. In most cases, they represent a more elemental breakdown of components previously described as basic, or data for which there only is an indirect requirement. In some cases the elements have been reestablished for structural purposes after having been deleted through the preliminary commonality matrix on the basis of content only. Such sources of change are to be expected as any conceptual design becomes more refined.

C. File Generation and Media

The number of basic data elements appears to be overwhelming, but closer examination shows that only a few of the files require extensive effort for generation and/or maintenance. It is useful to consider several in detail here before proceeding.

There are 12 basic data elements described for Pollution and Environmental Control Standards. Of these, elements (1), (2), (10), and (12) serve both to link with other files and sources of information and to convey data. Element (11) is an index only. The remaining elements serve to summarize the standard. All this information can be readily contained on a preprinted form. On the first reference to the standard, this form can be filled out. Thereafter, there will seldom,

if ever, be occasion to refer to the full text of the standard. There is considerable value to the data base system in having all standards, despite their disparate sources, in summarized form and uniform format. It simplifies the problem of answering queries about the standard and provides a suitable medium and form for dissemination to interested parties and operational personnel responsible for the standard's enforcement.

It should be noted that there is a requirement to establish a uniform method for identifying and indexing standard summaries and standards themselves within the NEPDB system because of the disparate sources from which the standards come. This method will have to be selected during the detailed design. It is possible that an accepted ..gal indexing scheme can be adopted to gain uniformity with outside legal libraries. (See Appendix C.)

There are no direct uses for the Geopolitical Location Directory shown on the commonality matrix. This and several individual basic data elements have been kept in the specification because of their value in maintaining the organization of the data base rather than their direct value in answering user queries. In fact, this file need be no more than an atlas or set of maps with locating gazatteer, on which Naval locations and pollution control authority jurisdictions have been identified.

Similar observations can be made for most of the other files. Some already exist in almost complete form within the Navy and can be adapted to the NEPDB system. Considerable effort cannot be avoided, however, in establishing others, particularly the Naval Locations, Facilities, Environmental Constituents, and Parameter Monitoring Activities files.

Quite apart from the question of the extent to which system operational functions should be automated, consideration should be given to the use of the computer as a tool in preparing and maintaining the various catalogs and directories through which data are accessed and the system operational functions accomplished. Suppose that, in initially building the data base and associated catalogs, various lists are prepared and put into computer readable form. For example, in preparing a catalog of pollution and environmental control standards, a list can be prepared showing, for each standard, the pollutants controlled. Later, in producing the facilities inventory, a second list, showing for each facility the pollutants emitted, can be prepared. By reading both lists into a computer and inverting and merging them, a catalog of pollutants showing relevant standards and emitting facilities is produced. The software required to produce such a catalog consists of a standard SORT-MERGE program, plus simple programs to accept and format the source lists and to produce the output catalog in appropriate format. As the source lists are updated, new pollutant catalogs can be produced almost immediately with little effort and at low cost.

This question is not addressed here in detail. Clearly, extensive use should be made of the computer in producing catalogs from merged, inverted lists. The kinds of catalogs that can be produced are somewhat more complicated than described in the example above, even with minimal software. There are several requirements and design decisions to be made if this use of the computer is to be effective. It is necessary to build glossaries of acceptable members and their spelling, use, and perhaps interrelationships for each of the categories to be listed. These glossaries can grow with the system, but preliminary glossaries of high quality and consistency must be available before data base assembly, organization, and indexing can begin. For example, in a library there are standard sets of subject headings and cross references that are used in indexing. These constitute a framework within which the subject catalog can be built and lead to consistent indexing practices. Similar frameworks and glossaries of terminology and/or membership are a prerequisite to assembly of the data base and its associated catalogs and directories. One would be required for pollutants showing spelling, categorization, hierarchical structure (e.g., showing that CO_2 is a constituent of the broader category of air pollution), and so on. Others would be required for facilities, materials and supplies, and so on.

Second, it is necessary to decide on a sequence--a set of procedures--that produces the most efficient generation of the data base organization. By choosing which lists are to be prepared manually and which by computer aids through inversion and merging, considerable savings in total data base assembly time and organization costs can be realized. Selecting such a set of procedures, however, requires careful study of available resources. It is assumed that there exist within the Navy various computerized listings of facilities, materials and supplies, directives, locations, and so forth. These computerized listings, appropriately augmented, should form the basis for generation of much of the catalog and directory material for the data base. Standards for these listings have already been established. It will be necessary during the detailed design to make an inventory of these resources, their contents, organizations, standards, and constraints, in an effort to reduce the total data base organizational cost, to reduce implementation time, and to make most effective use of the computer as a tool in organizing the data base. The categories in Table 15 for which there is little justification in the commonality matrix have been retained because of their potential value in simplifying the data base organization and maintenance procedures and requirements.

XI ALTERNATIVE SYSTEM OPERATIONAL COMPONENTS

Three quite different major areas relating to system operations have been considered here:

- Centralization/decentralization of operations
- Manual/automatic operations
- Index and storage/retrieval media.

The selection of an alternative from each area has a significant effect on a candidate system structure in terms of cost-effectiveness and system implementation time. Therefore, these alternatives have been carefully developed and analyzed to provide a basis for the trade-offs made in Section XIII.

A. Centralization/Decentralization of Operations

Centralization can refer to any one of many system resources and is considered to mean the concentration of all of a given resource at one location. Decentralization therefore implies that more than an insignificant portion of a system resource is geographically separated from the rest of that system resource. As examples, the present environmental data collection effort is being done by several groups at different locations; the present NEPDB division, L-71, is centralized at Port Hueneme; and division L-72 operates out of Port Hueneme but has some decentralized

efforts. Additionally, there are pilot collection efforts, e.g., division L-73 at Pearl Harbor, that are decentralized from the main Port Hueneme effort.

There are two major system elements in which centralization/decentralization is significant--location of data storage and system equipment. Because of the disparate Navy organizations collecting environmental data, the implications of data storage locations strongly affect the determination of system equipment and its location, as well as the determination of personnel and system operating rule selections. Therefore, data storage location alternatives and their characteristics will be discussed first and, using these alternatives, the secondary centralization/decentralization considerations will be addressed. These secondary considerations are listed below in the order of their importance:

(1) Location of personnel

(2) Control of data at a NEPDB location

(3) Location of a NEPDB subfunction.

A basic assumption for data storage is that external data base contents will not be duplicated by the NEPDB, except for those data generated within the NEPDB system.

1. Measured Environmental Data

At the present time data are being collected by several Navy organizations: the EFDs, the Navy bases, NCEL reconnaissance teams, and

various Navy laboratories. In theory, all these data would be accessible by the NEPDB system, and copies could be physically located at the NEPDB Center; in practice, certain sensitive data collected by local Navy bases may in some cases be difficult to obtain. By designing security procedures into the NEPDB system, assurances can be obtained that the sensitive data would not be released without authorization of the Navy Base Commanding Officer. It is important to have security procedures of this type to ensure that potential system users and contributors would have sufficient confidence in the system to employ and to support it; however, it should be realized that the Navy internal operating characteristics may be of such concern to a Navy Base Commanding Officer that he would demand that the system prove its security procedures effectiveness before his full support would be given.

Alternatives for measured data storage can be listed as follows:

(1) Data are stored by the collecting agencies as now organized, and the system has pointers in the central data base to locate all relevant data.

(2) Copies of all data collected by agencies are located in the central data base.

(3) Data considered sensitive at the Navy bases will be kept at the bases, but copies of all other data will reside in the central data base.

2. Other Environmental Data

There are several types of nonmeasured data that the data base must be capable of accessing. These data can be categorized on the basis of the amount of data and frequency of use, as follows:

Category 1 - Nonvoluminous data that will be accessible relatively often:

(1) DoD/Navy directives.

(2) Navy installations/activities/facilities inventories.

(3) Ecology/biology statistics as related to Navy environmental protection responsibilities.

(4) Pollution and Environmental Control Authorities' jurisdictions and responsibilities.

Category 2 - Nonvoluminous data that will be accessed relatively infrequently:

(5) Navy operating procedures as related to the environment.

(6) Navy training and personnel certification requirements related to environmental protection.

(7) Navy organizational relationships related to environmental protection.

Category 3 - Voluminous data that will be accessed relatively often:

(8) Standards/laws and the like.

(9) Abatement plans, equipment, and costs.

Category 4 - Voluminous data that will be accessed relatively infrequently:

(10) Construction plans, permit requirements, and costs.

(11) Reports/surveys and the like, generated by Navy and non-Navy sources, that are applicable to the Navy's environment protection responsibilities.

(12) Environmental techniques, methods, instrumentation, and so on.

Since these data are voluminous, the selection of their location is vital to the development of a feasible system. It is clear that many data of interest are located in external data bases or data size and expected frequency of use would tend to prohibit duplication. In such a case, that data base will have pointers that permit it to be located easily.

With the above assumptions being implicit, selected alternatives for data located centrally can be cited as follows:

(1) Central storage: Categories 1 and 2
Pointers only: Categories 3 and 4.

(2) Central storage: Categories 1 and 3
Pointers only: Categories 2 and 4.

(3) Central storage has Category 1 data with portions of Category 3 data and has pointers to the remainder of Category 3 and Categories 2 and 4 data.

(4) Central storage has Category 1 data with summarized data from Category 3 and pointers to Category 3 data locations with complete data. Only pointers are used for Categories 2 and 4.

(5) Other mixtures of the above items (1) through (4) that can be employed will be considered.

If data storage is completely centralized, then computers and other equipment will also be centralized. In addition, function location, data control, and personnel for the data base operation will be centralized.

If collected data are stored as at present, then, since only a small amount of computation is required before data are brought to the central data base for use, computation will not be decentralized. Communications and possibly microfilm equipment may be required away from the NEPDB center. Control of data and certain data organization and retrieval functions are remotely employed. There is a requirement that either NEPDB personnel stationed with the data or local Navy personnel will be required to act as part-time members of the NEPDB system.

If only Navy base sensitive data are stored outside the central data base, then it is likely no additional equipment will be added to the standard equipment already at the Navy base. The Navy Base Commanding Officer would have control of the data, and part-time assistance of the Base Environmental Officer or the Public Works Officer will be needed.

Data other than environmental measurements are currently located at widely separated points within the Navy. Thus, if the data are completely centralized or decentralized as described directly above, there is no need for decentralized computation. The control of data, location of functions, and personnel requirements for this type of data would follow the two cases cited in the above two paragraphs.

B. Manual/Automatic Operations

The previous discussions on centralization/decentralization alternatives showed that the interdependence of data storage location, equipment, and other considerations forced broad analysis of all these items together, rather than analysis of alternatives individually. Similarly, these analyses cannot be separated from manual/automatic operation analyses since the choice of one strongly affects the choice of the other. However, some broad alternatives can be posed with the provision that later trade-off analyses will combine the alternatives at that time.

Since the present NEPDB operation has access to computers and is currently using some automatic processing, the possible alternatives will not include a completely manual system. The following general alternatives shown in Table 22 form a basis for the studies discussed in Section XIII.

Table 22

AUTOMATIC/MANUAL OPERATIONS ALTERNATIVES

Alternative	Request Handled Manually	Basic Data Processed Manually	Limited Computer Capabilities* at NCEL with Enhancement Up to 1 July 1973	Manually Generated Indices/	Computer Generated Indices/	Microfilm Working Storage
1	X	X	X			
2	X	X	X	X		
3	X	X	X		X	
4	X	X	X	X		X
5	X	X	X		X	X

*Some availability of CDC and IBM computers, System 2000, files on some water quality data and oil spill data.

/ Indices provide locations of standards, pollution control authorities, Naval elements, facilities inventory, data sets containing measured parameters, and so on

C. Index and Storage Media

Three media have been identified as prime candidates for use as the medium of storage in the data base and data base index: computers, microfilm, and hard copy. A brief discussion of their respective advantages and disadvantages is given below, followed by a discussion of some possible hybrid configurations.

1. Computers and Computer-Readable Media

The prime advantage of storing data in a computer is the speed with which data can be retrieved and processed. The faster things have to happen and the more complex the numerical calculations, the better the computer appears in comparison to other ways of doing things. This is especially true where the computer is interfaced with other machines rather than with human beings. Computer-processing times are so much faster than the reaction times of the humans who sit at the terminals that one computer can service dozens of users simultaneously.

A major disadvantage of the computer is that it can do only what it is told to do; that is, it must be programmed to handle a particular function. So, while it is doing something it "knows" how to do, it is efficient. But many complex, nonrepetitive processes require constant interaction of a human being to supply the necessary judgment and decisions. The greatest potential disadvantage of the computer is its cost, and the measuring stick is the cost of doing the same thing

without a computer. For example, calculations run on a computer that is running at only 5 percent of its capacity may still be cheaper than if made by a staff of trained people. But if the computer is being used solely to retrieve data without also performing some type of calculations, then an alternative method may well be cheaper.

Computers are also limited in their capacity to store photographs and other facsimile material.

2. Hard Copy

A major advantage of hard copy storage is that no keypunching or other transformation is required for either input or output; data handling and equipment costs are thus minimized. On the other hand, hard copy is the bulkiest data form for storage and usually the slowest to retrieve; misfiled and lost documents are also likely in a hard copy system. But where data volume and retrieval activity are very low, it is usually the most cost-effective.

3. Microfilm

In many respects microfilm occupies a middle ground between computer memory and hard copy and can be more cost-effective than either. A major disadvantage of microfilm is that it requires special equipment to perform both the input and output functions. Its advantages include: reduced storage area, ease of duplication and dissemination, uniform size and formats, and facsimile storage capability.

Indexing material on microfilm can be done in several ways. Because of standard formats, each page on a microfiche is in a particular location that can readily be located either manually or automatically. An index may indicate the location of particular material by citing a fiche number and frame, or the first frame of a microfiche can be used as an index to the contents of the remaining pages on the fiche.

Currently being marketed are several microfilm retrieval devices that combine a computer index with an electromechanical storage unit. The computer can drive the storage unit to retrieve a particular microfiche and display a particular frame of that fiche. Simpler microfilm storage units are also available,

4. Hybrid Configurations

When only "pure" systems are considered, nine combinations are possible from three media and two components:

	Index	Data Base
(1)	Computer	Computer
(2)	Computer	Microfilm
(3)	Computer	Hard Copy
(4)	Microfilm	Computer
(5)	Microfilm	Microfilm
(6)	Microfilm	Hard Copy
(7)	Hard Copy	Computer
(8)	Hard Copy	Microfilm
(9)	Hard Copy	Hard Copy

Combination (1) represents a highly automated system, appropriate where there are many inquiries to the system and many calculations are performed on the data. At the other extreme, combination (9) is appropriate for a very manual system with few inquiries and few standard calculations with the data. Combination (2) might be best where there is need for a fairly sophisticated index and there are several decentralized data base locations, each of which contains much of the same material. [The low cost of duplicate microfiche makes combination (2) preferable to combination (3) in such a case.]

One could start with a combination (9) system that, over a period of time, could evolve into a combination (1) system. For instance, the data base could be changed from a hard copy basis to a microfilm basis when that particular change could be justified in terms of cost efficiency.

This suggests another aspect of "hybrid" systems. It may be that some part of the data base should be converted to microfilm but not another part. Or some index information might be kept best on an interactive computer system and other index material should be kept in other forms. For convenience, these configurations are referred to as "mixed" rather than as "pure" systems. Thus, one could end up with a "mixed" system that was part combination (9), part combination (8), and part combination (1).

There is yet another aspect of hybrid systems that needs to be mentioned here: the case of one medium preparing material for use in another medium. Consider the situation where very large multileveled indexing is required, but the number of queries and size of the index do not suggest a computer-based index. How can such an index be built and maintained? The answer may be to store the index on a computer-readable medium, such as magnetic tape, but not on an on-line medium. The index can be updated periodically by the computer in a batch mode and then output either on a printer for hard copy usage (e.g., a phone directory) or by a COM camera for microfilm usage.

5. Media Selection Factors

As suggested above where the computer was discussed as a medium, the selection of one medium over another in a particular application is usually based on minimizing the cost to perform a given function. Five factors are usually sufficient to determine which approach should be taken: hardware cost, support costs, conversion costs, access time, and frequency and urgency of requests.

a. Hardware Cost

This refers only to the cost of hardware that is necessary to perform the desired function. In a computer system hardware cost would include the computer but not the keypunch machines; in a manual system it would include the cost of filing cabinets. The more automated the system, the larger this factor as a percentage of the whole.

b. Support Costs

Support costs refer to those items that are necessary for the hardware to function, such as software, floor space, ambient preparation costs, programmers, operators, filing clerks, and the like.

c. Media Conversion Costs

These costs are costs associated with getting material into and out of the storage medium; they include keypunch machines and operators, optical readers, microfilm cameras, microfilm readers, and electrostatic copiers. The purpose in calling out these three cost categories is not to be pedantic about what costs fall into what categories, but rather to help identify all relevant costs.

d. Access Time

The main reason for having a nonhard copy system is that the retrieval can be faster. If it takes as many man-hours to retrieve a group of requests from a computer system as from a hard copy system, then money is being wasted. Hence, the value of knowing the (expected) access time associated with a particular storage or index medium.

e. Frequercy and Urgency of Requests

The request frequency and access time yield cost information that should be included under the topic of support costs. They also yield information about the load on the system and need to be considered in

light of the possibility of saturating the system, especially at peak loads. The capacity of the system and the load on it must be considered in light of the urgency of the requests upon it.

XII EVALUATION CRITERIA

Seven major criteria were established for evaluating the trade-offs determined throughout the study. The criteria were applied during the course of the study to eliminate the system alternatives that were clearly infeasible. These criteria are as follows:

(1) The system must meet all the constraints imposed at the beginning of the study (discussed in Section IV). The most stringent of these constraints was the one requiring the initial system to be implemented by 1 July 1973. Its effect was to limit severely the development of computerized functions in the initial system. It should be noted that this restriction of the initial system by no means precludes the growth of the system in its second and succeeding stages from employing computers and sophisticated software to a large degree.

The second significant constraint is that the system must be feasible within Navy organizational and operational limits. This constraint eliminates alternative systems that violate Navy procedure, formal and informal.

(2) The data base system must provide maximum utility to the user within the system constraints. Several factors provide user satisfaction, some tangible and some intangible. The tangible factors include the time delays the user encounters, the reliability of the answer, the ease of system use, and the reliability or uptime of the system. The intangible factors include the quality of the response obtained, the format of the answer (ease of use of the document obtained), and the amount of data presented to the user that may not be wanted.

(3) The system must be cost-effective. There are many cost items in the system and several operations that must be considered for their effectiveness. The detail to which a conceptual design can identify costs and effectiveness is limited because of the lack of specific information or detailed design

of the system. Nevertheless, trade-offs are possible and can be identified. It is clear that costs include money, personnel, and time. Measures of effectiveness include speed, reliability, ease of use, flexibility, and the like. Index and storage media costs can be estimated, as can their relative effectiveness. The performance of an operation, manually or automatically, can be analyzed for cost and effectiveness. The location of the data, equipment, and personnel contribute to the costs and effectiveness of the system, and estimates of relative values are sufficient for the purposes of this study.

(4) The system design must provide growth, modification, and flexibility capabilities. Demands on the system will change with time. As environmental technology improves, new or modified methods will be required. Futhermore, these changes modifications cannot all be predicted clearly at this time. Therefore, it is important that the system allow for a wide variety of changes/modifications to be made on a step-by-step basis without excessive expense or concomitant disruptions in service to users.

(5) The system must be feasible despite the uncertainty of measured environmental parameters and technology. Any data base system that expects to be of value to its users must provide for uncertainties in the data. Since decisions, plans, construction, and the like are to be made on the basis of these data, the system should have knowledge of the quality of data it is handling and should ensure that the user is informed of the quality of data he is receiving.

(6) Adherence to response time/queueing requirements. The success of the NEPDB system will be affected by the swiftness of its response to users. Again, the acceptance of the system and the expectation that it be used throughout the Navy are dependent on reasonable system response to user request. The queueing requirements can be converted directly into response time requirements and, therefore the system ability to limit queues will provide abilities to meet response time deadlines. It is to be expected that peak request occurrences could cause some questions to be delayed and some queueing as well; therefore, the system must be designed to smooth out peak occurrences as much as possible within other constraints.

(7) Amount of questions answered. This criterion is of less importance than the preceding ones; however, it provides a measure by which one can determine whether the system might expect to

survive over a long period of time. A major element of this criterion is the number of high priority questions that can be answered because it is obvious that high priority questions represent urgency and hence relate to user acceptance of the system.

XIII TRADE-OFF ANALYSES

The approach used by SRI to develop a conceptual design included the application of procedures for successive filters to reduce the number of possible subsystem candidates. In this way subsystem candidates were eliminated when it was found that a system incorporating them proved infeasible because of: (1) inability to meet the specified initial system implementation date, (2) high cost that outweighs any possible effectiveness and/or user utility, (3) ineffectiveness that outweighs low implementation costs, (4) inability to be adapted to established Navy procedures and/or organizational division of responsibilities. These filters were applied throughout the study, and their use enables the number of feasible final subsystem candidates to be limited to a relatively small number.

The prime criterion that had the greatest effect on the inclusion of a given subsystem design was the initial system implementation date constraint. Consideration of the use of automatic data processing in the initial stage of the NEPDB was restricted after the time required to design, code, and thoroughly check out computer programs needed to automate NEPDB system functions had been analyzed. Specific trade-off analyses vital to the conclusions obtained are shown below.

A. Centralized/Decentralized Operations

The application of the constraint requiring a feasible system design within the Navy organizational and operational framework led to the reduction of data storage location alternatives to:

(1) A central data base, except for Navy base storage of locally collected measurements.

(2) A central data base containing all the data.

The first alternative was obtained under the assumption that data collected at a Navy base could not be released without the authorization of the Commanding Officer or his designee. The most cost-effective storage of that locally collected data appears to be at Navy bases because of the number of parameters being measured and the measurement frequencies.

The second alternative requires duplication of data from the Navy bases in the central data base since Navy bases will continue to collect and store their individually collected data.

B. Manual Versus Automatic Index Generation and Maintenance Trade-Offs

The contrasts and trade-offs between manual and computer-aided index generation and maintenance are in fact somewhat less pronounced than might be expected. To identify the trade-offs and cost differentials it is necessary to consider index generation and index maintenance as separate subjects.

The basic steps in generating an index have been described in Section XI. These are:

(1) Identifying existing resources. In Sections XIII and X the data were divided into 15 categories, of which no fewer than 12 constituted indexing dimensions. There already exist, within the Navy and elsewhere, organizations of data and associated attribute information that constitute potential frameworks for index generation for several of these dimensions. The Navy Facilities Index is a major example. Even though significant modification and augmentation will be required to transform these existing data organizations into suitable NEPDB indices, they constitute valuable resources and represent extensive data collection and organization effort that should not be duplicated in generating the data base and its indices.

(2) Preparing glossaries, indexing frameworks, and indexing standards. Certain of the indexing frameworks and standards will be imposed by the existing resources selected. For data categories and indexing dimensions for which no existing resources are identified it will be necessary to establish indexing frameworks and standards and to prepare glossaries of indexing terms showing acceptable spellings, alternate spellings and nomenclature, possible inversions, cross references, and so on. The index formats and media for all categories will have to be selected.

(3) Preparing basic indices and lists. It is next necessary to catalog the initial content of the data base. For example, all available Pollution and Environmental Control Standards will be summarized according to the framework and procedures established for that category. No attempt is made during this step to complete cross references and linkages. That is, in cataloging standards the pollutants controlled are identified and included in the standard's summary, but no attempt is made to cite the standard under the corresponding entries in the pollutant index catalog.

(4) Sorting, merging, and cross-referencing. Finally, the cross references and linkages are completed.

For both manual and computer-aided index and catalog generation, steps (1) through (3) are performed in approximately the same manner and are largely manual tasks. Steps (1) and (2) are largely intellectual tasks

and, once completed, are seldom repeated unless new data categories or linkages are introduced into the data base system. Step (3) is largely clerical, although for certain data categories, judgments and intellectual decisions must be made.

It is at step (4) that the major trade-off occurs. If indexing is done manually, step (4) requires access to and updating of all linked categories. Thus, in cataloging a pollution control standard, the index catalogs for Pollution Control Authorities, Naval locations, Naval facilities, and environmental constituents and pollutants are all accessed and cross-reference citations to the standard are made under the appropriate entries in each of the index catalogs. Step (3) must be completed before step (4) is performed if multiple passes through step (4) or dummy index entries to carry cross-reference citations are to be avoided. In the first case, the labor cost is significantly increased; in the second case, control and integrity of the index catalogs rapidly deteriorate. Even under the best of conditions and procedures, step (4) is a costly, difficult, and time-consuming process when done manually, and errors of omission and commission will almost certainly be introduced into the cross-reference linkages. The more complicated the catalog interrelationships and linkages, the more costly, difficult, and prone to error is step (4).

The alternative is to perform step (4) by means of a computer. This requires that all the information generated in step (3) be put in computer-readable form and made into computer files. By appropriate

sorting and merging, all cross-reference linkages can be completed and the index catalogs produced in the appropriate media and formats. When minimal computer aids are employed, software generation is largely trivial. For the most part the software consists of invoking standard file generation and maintenance software and SORT-MERGE software in appropriate sequences and with appropriate parameters. The features available in the COBOL language are ideal for this purpose. More extensive software aids include checks and validation of the index entries as they are read into the computer; for example, all spellings can be tested against appropriate glossaries and exceptions can be noted.

The advantages of performing step (4) by computer are not without cost. The data capture and capture proofing and verification steps can require significant effort. Thus the manual effort required to complete step (4) is not eliminated but rather displaced. The qualifications of the personnel required are different. The major difference between manual and computer performance of step (4) is the manner in which errors are introduced and propogate through the indexing organization. In both cases errors can be introduced during transcription (capture). In the manual case, additional errors can be introduced during the cross referencing and linking that do not occur with computer generation of cross references.

(Note that the capture cost is not exclusive to the computer approach. If the indices are prepared manually, there is a transcription cost to the desired final format and medium. This partly offsets the

capture cost for the computer-aided approach and constitutes a source of error similar to that associated with data capture for computer input. In both cases, of course, there is an initial data transcription. The extent to which data capture costs are offset is a function of specific requirements for retranscription to final format and medium in the manual case, and varies from one index to the next.)

Other than the qualitative advantage of the computer-aided approach--fewer sources of error--there is thus no clear cut cost advantage to either method. Some rules of thumb can be applied:

(1) When the number of indexing dimensions is small (for example, three dimensions) the manual approach is more cost-effective. As the number of indexing dimensions increases, the computer-aided approach becomes more desirable.

(2) When the linkages between the indexing dimensions are simple, the manual approach is more cost-effective. As the complexity of the indexing dimensions increases, the computer-aided approach becomes more desirable.

(3) When the linkages between the indexing dimensions are few, the manual approach is more cost effective. As the linkages and cross references become more dense, the computer-aided approach becomes more desirable.

By all three measures, the computer-aided performance of step (4) in generating index catalogs is found to be desirable. The number of indexing dimensions is large (12 dimensions) and the cross-reference linkages are both complex and dense.

Any accurate quantitative assessment of the trade-off, however, cannot be made until step (1) of the index generation procedure is

completed. This step is the same regardless of which approach is chosen. Step (1) should be completed as a part of the preliminary system design, at which time a thorough analysis and cost/quality trade-off can be made. The manner in which the remaining three steps are performed is to be decided early in the detailed NEPDB system design. At this time, it appears that computer-aided index generation is both desirable from quality considerations and cost-competitive with manual approaches.

Index maintenance is a further consideration. Addition of data elements requires that steps (3) and (4) be performed on an individual data element basis. The above discussion applies. However, it is clear that new index catalogs cannot be produced by computer whenever a new data element is added. There are several alternatives:

(1) The indices can be maintained manually between computer generations of new sets of catalogs. Errors will gradually be introduced between computer updates. The computer updates should thus be a balance between cost and acceptable levels of error in the catalogs. This method keeps the indices current at all times but has highest cost. It is suitable if the data base changes steadily at a relatively low rate.

(2) Addenda to the index catalogs can be produced by computer fairly frequently (e.g., weekly) with regeneration of the full catalogs occurring at more widely spaced intervals. This is a less expensive method, but the index catalogs are not kept current. Data may be in the data base for up to a week before they are generally accessible through the indices.

(3) The prime index to a data element can be inserted into the indices manually, with cross references only being generated weekly as addenda [approach (2)] or waiting for the next catalog generation [approach (2)].

There are a number of mitigating considerations, and the choice for one index dimensions may not be suitable for another. SRI prefers a combination of approaches (3) and (2). The main advantage of a computer aid in both index generation and maintenance is the elimination of key sources of error to allow a high standard for index accuracy and integrity to be maintained. This advantage becomes more important with the passage of time. It remains to find the schedule for computer update of the index catalogs that strikes the best balance between index currency and cost.

Index medium becomes an important consideration. Indices in card catalog or loose-leaf form can be updated far more simply than book form index catalogs and can broaden the scope of possible alternatives. Computer-produced addenda can readily be incorporated and the time between complete computer regenerations can be more widely spaced. It is likely that for certain data categories the index entries will consist of both computer-produced data and linkages and manually produced comments and annotations. The manual information will want to be carried across several computer addenda and/or regenerations without requiring capture into computer-readable form. This requirement is most easily supported if the card/loose-leaf index is selected.

As before, no definitive trade-off can be made until step (1) in the index generation procedure is completed as part of the preliminary design. However, on the basis of current understanding of the dynamics of the data base it is considered that both computer-aided generation

and maintenance of the indices are desirable. For maintenance, the third alternative discussed appears at this time to be preferable, utilizing loose-leaf index organizations to the extent possible.

C. Index and Storage Media Alternatives

1. Media Effectiveness Comparisons

a. Microfilm Working Storage Description

For most of its existence, microfilm has been regarded solely as an archival medium, inappropriate for daily usage. The cost advantages of microfilm and improvements in microfilm hardware have combined in recent years to cause a revaluation of this position. Microfiche, a 4 inch x 6 inch piece of microfilm, seems to be gaining in popularity because of its random-access-like features. Although other forms of microfilm share some of the same advantages, the discussion in this report is particularly directed toward microfiche.

It is helpful to distinguish among three classes of microfilm systems: microfilm readers, manual storage systems, and automated storage systems. To use a microfilm reader, the user must retrieve the fiche from the bin or drawer where it happens to be stored. It is then manually inserted into the reader and positioned to display the desired frame by use of a "joy stick." To satisfy many of the requests envisioned for the proposed NEPDB system, successive searches will be required. That is, a search of one volume or index or file will lead to the search of another. If these various files are in hard copy form, even though

they may be computer printout and stored in the same room, it is more time consuming and inconvenient than searching through the corresponding microfiche all within arm's reach on one's desk.

Some readers also have a hard copy printer capability. A print is generated by merely pushing a button. The cycle time on most printers is 5 to 10 seconds. If a particular page is to be sent to the requestor or to someone else within the NEPDB system, then the use of a reader/printer is about as efficient and inexpensive as using an office copier to copy a full-size page.

In manual storage systems, the fiche are physically stored within the reader unit. A fiche is retrieved and displayed by typing the fiche number on the unit keyboard. Selection of a particular frame for viewing is likewise made by punching a row and column selection button on the keyboard. Total keystroke and retrieval time is about 5 seconds.

Automated storage systems are driven by a computer, which causes the selection of a particular fiche and the display of a particular frame as a result of an index search or other computer-based operation.

b. Microfilm Working Storage Effectiveness

The use of microfilm as a working storage medium has several potential advantages over hard copy storage techniques. Its compact size usually means that all the files are within reach of the person who has to retrieve them. Having to get up and walk to a file

cabinet each time a file is to be retrieved or refiled can be both time consuming and bothersome. Access time to a particular microfilmed document or page is usually faster than with hard copy systems.

Out-of-file conditions can be eliminated. The ease and low cost of duplicating microfilm means that multiple copies can be provided to each potential user.

Microfilm is more durable than paper. It can be handled, used, stored, and transmitted without loss of legibility. As a safety precaution, it is not uncommon to make a vault copy microfilm, which is stored in an archive while working copies are circulated.

Misfiled and lost documents are less common with microfilm. And, since duplicate backup copies are inexpensive and easily stored, when a fiche is lost, it can easily be replaced. By the same token, when material becomes out of date, it is an easy matter to replace a given fiche.

Major advantages of microfilm working storage are the corresponding reduction in hard copy usage and the reliability obtained thereby. The associated disadvantage is that people are not generally used to reading material from a viewing screen. The temptation, therefore, is for the user to request a hard copy of the microfilm image for study. The cost advantage of training or otherwise persuading people to do without unnecessary hard copies of microfilm images is clearly defined: it is the cost of producing and subsequently disposing of the hard copy, or about 2 cents per page <u>minimum</u>.

2. Media Cost Comparisons

In Section XI the major advantages and disadvantages of three potential storage media are outlined: computers, microfilm, and hard copy. The cost relationships of these media are given below.

a. Computer Costs

Total NEPDB system demands for computer processing are not sufficiently quantified to justify consideration of a dedicated computer facility. To justify such a system would require a reasonably accurate projection of computational demand over the expected life of the computational facility--certainly for no less than three to four years. Currently available data are not adequate to make such a projection.

There are other considerations. The short time frame for system implementation makes acquisition of a dedicated computational facility undesirable because of delays associated with gaining necessary approvals and obtaining delivery and installation. With a dedicated computational facility it would be necessary to bear the full cost of the facility regardless of the utilization.

It is suggested that the preferable alternative is to make use of existing and available computational facilities, at least during initial phases of system implementation and operation. After system operation has stabilized so that accurate projections of long range computational requirements can be made, justifications for acquisition of dedicated computational facilities should be reconsidered. It is

noted that the NEPDB system as specified in this conceptual design has computational requirements that are almost certainly too modest to justify a dedicated computational facility.

During system implementation and initial phases of operation, the bulk of the data processing costs is likely to be associated with data capture. For purposes of planning and system costing, it is noted that costs for data capture--keypunch and verify--are typically 2 cents per card.

b. Microfilm Costs

It costs 2 cents to 4 cents per page to convert hard copy material to microfilm when the output is a 4 inch x 6 inch microfiche containing 100 to 300 pages. This cost includes material, operator time, and an amortized hardware cost. Microfilm service bureaus also produce microfiche for this cost.

As far as storage space is concerned, the microfilmed contents of ten 4-drawer file cabinets can be stored in a file the size of a shoe box. Good desk top microfiche readers are available in the $100 to $300 price range; more automated desk top units sell for $2,000 to $5,000. These units will hold up to 750 fiche containing 5 million lines of print and display any frame on any fiche in a matter of seconds.

Many microfiche readers are equiped with hard copy printers. This enables the user to obtain Xerox-type reproductions of microfilm images at the touch of a button. Per copy costs are as low as 2 cents for paper and toner.

c. Hard Copy Costs

Equipment and space costs for hard copy storage are small unless the files become volumnous, in which case the costs can exceed the cost of storing the material on microfilm or computer storage media. The cost of filing clerks is the largest single cost in hard copy storage. A rough rule of thumb is that personnel costs are two-thirds of the total costs of maintaining a manual file system. Depending on the number of filing cabinets assigned to each clerk, this total cost is probably 5 cents to 10 cents per page per year.

A major hidden cost factor in manual systems is the imputed cost of misfiled documents. Industry sources estimate this cost at $50 to $100 per misfile in wasted searching time.

Gross comparisons of these trade-offs for cost, speed, and cost-effectiveness are shown in Figure 26.

MEDIA	COST	SPEED
HARDCOPY	LEAST	LEAST
MICROFILM	SOMEWHAT ABOVE HARDCOPY	SIGNIFICANTLY FASTER THAN HARDCOPY
COMPUTER	MOST	MOST

(a) TRADE-OFF COMPARISONS

MEDIA	INDEX	STORAGE
HARDCOPY		C/E FOR SMALL VOLUMES
MICROFILM		C/E FOR LARGE VOLUMES
COMPUTER	DATA NEEDED OFTEN C/E	

(b) COST-EFFECTIVENESS (C/E)

FIGURE 26 GROSS COMPARISONS OF TRADE-OFFS

XIV SYSTEM SYNTHESIS AND RECOMMENDATIONS

At this point a great deal of effort has been expended on development of alternatives and applying evaluation criteria to trade-off analyses of these alternatives. This effort has laid the foundation for the synthesis of candidate systems and the selection of final recommendations for implementation and recommendations for the study of assumptions made during the course of the conceptual design.

A. System Synthesis

The three main elements of a candidate NEPDB system are its configuration, its operations, and its storage media; all other aspects of the system can be derived from these three.

1. System Configurations

Previous analyses reduced configuration alternatives to two: a centralized data base system with centralized data storage and a centralized data base system with decentralized data storage. Of the two a central data base system with decentralized data storage at Navy bases was determined to be feasible within Navy organizational and operational limits and more cost-effective. The only qualification to this conclusion was the possibility that, after a period of time, security procedures would be incorporated into the NEPDB system to ensure Navy users that their collected data would not be released without proper authorization. When

security procedures are considered adequate, copies of user data or portions thereof can then be located at the central data base. Since this latter possibility would necessarily have to be realized first, the system configuration recommended was the former mentioned above.

Figures 27 through 30 show the four configurations considered.

2. System Operations

The analyses of alternatives postulated for system operations produced the conclusions that:

(1) The system should handle manually most of the data processing.

(2) The present NCEL computer capabilities should be retained and enhanced after the 1 July 1973 implementation date.

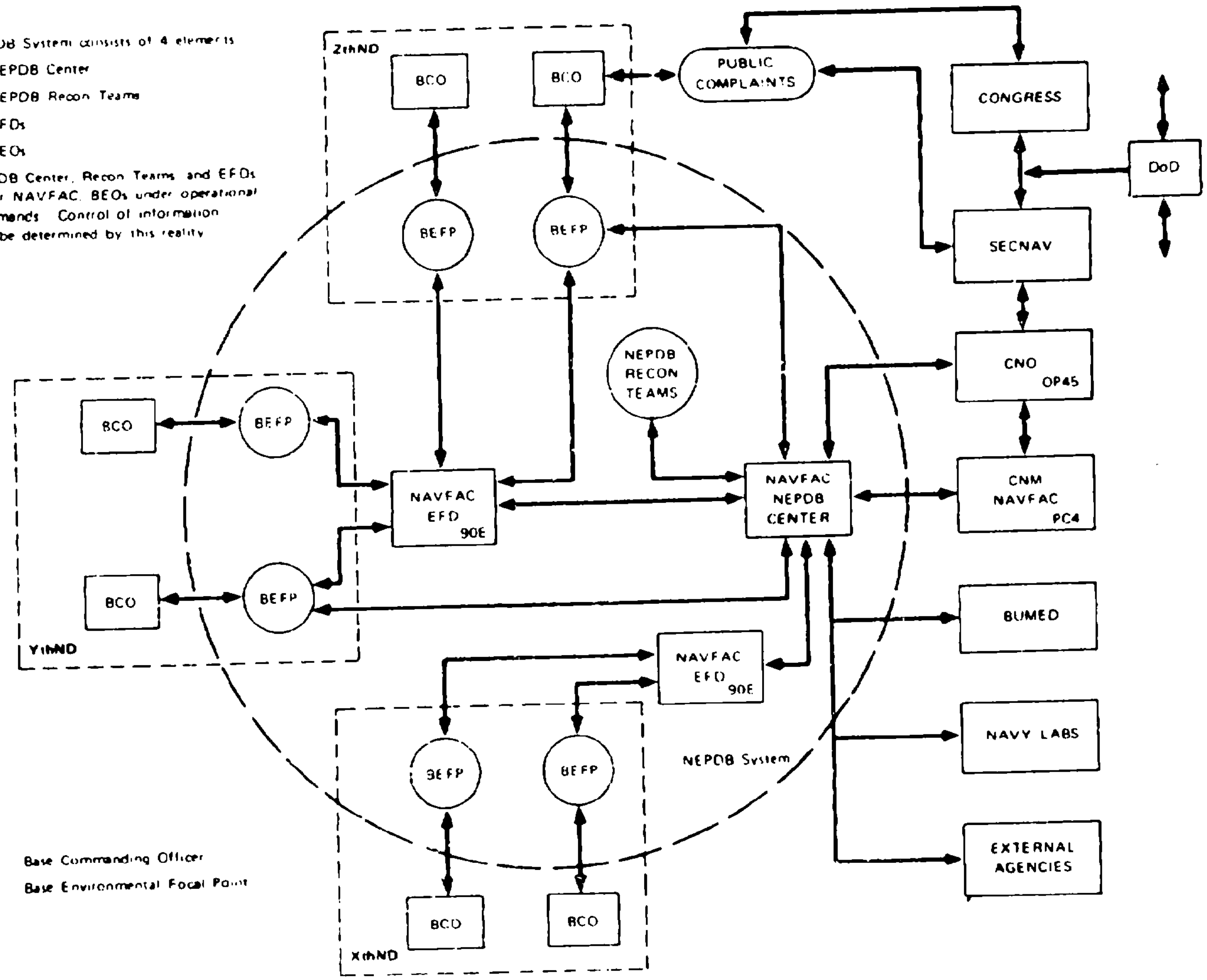
(3) Either manually-generated or computer-generated indices to locations of standards, pollution control authorities, Naval elements, facilities inventory, and data sets containing measured parameters should be implemented.

Additional design efforts outlined substantially the data files, data organization, and data indexing that will be required for the system.

The alternative of employing a microfilm working storage capability was analyzed, and trade-offs between this capability and other manual and automatic capabilities were examined.

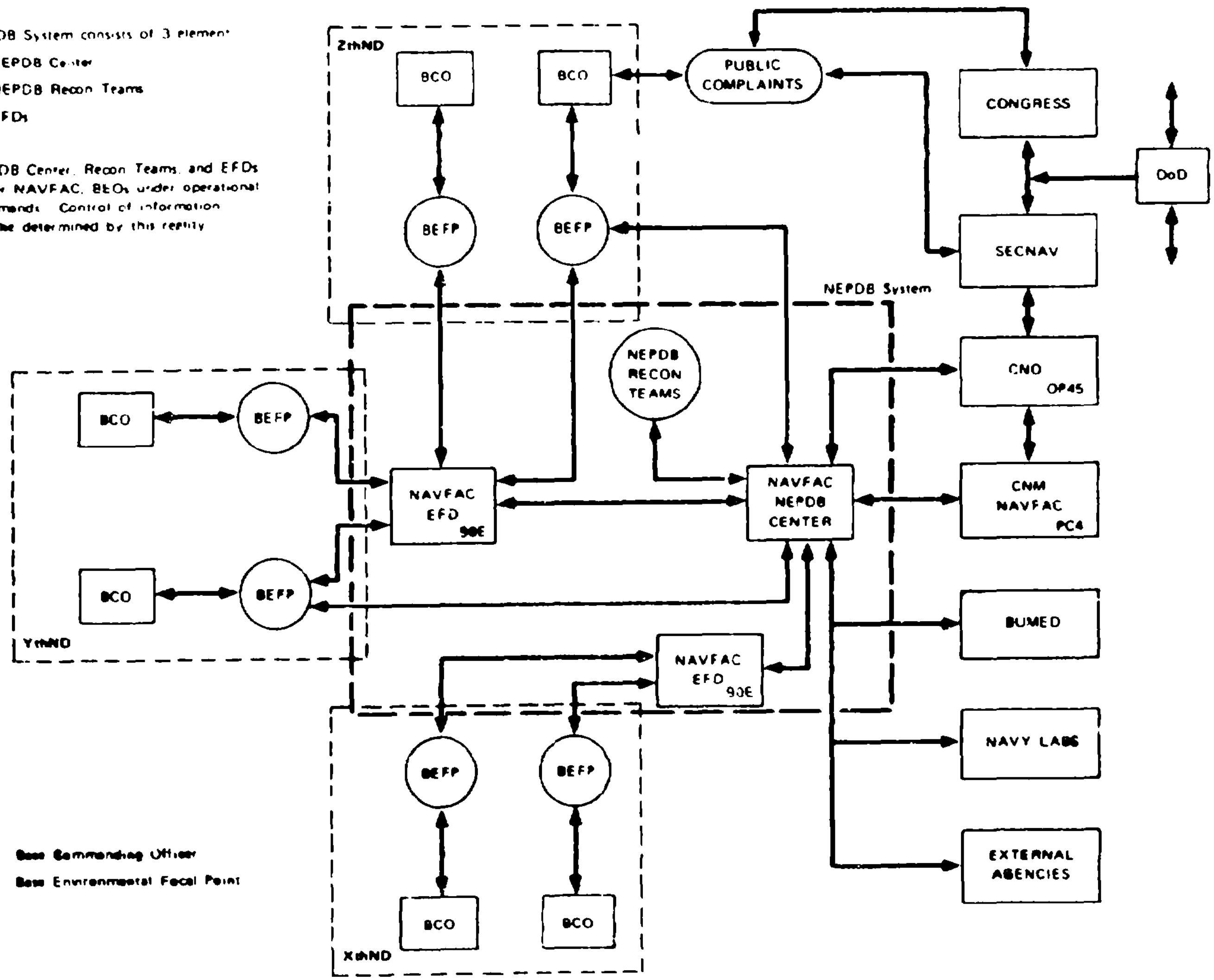
The result of these analyses led to the conclusion that computer-generated indices rated highest because of cost-effectiveness and growth and system capabilities for answering user requests within response time/queueing requirements. However, the procedures for manual

1. NEPDB System consists of 4 elements
   - NEPDB Center
   - NEPDB Recon Teams
   - EFDs
   - BEOs
2. NEPDB Center, Recon Teams and EFDs under NAVFAC. BEOs under operational commands. Control of information will be determined by this reality



BCO Base Commanding Officer
BEFP Base Environmental Focal Point

FIGURE 27 NEPDB SYSTEM CANDIDATE CONFIGURATION 1



1 NEPDB System consists of 3 element

- NEPDB Center
- NEPDB Recon Teams
- EFDs

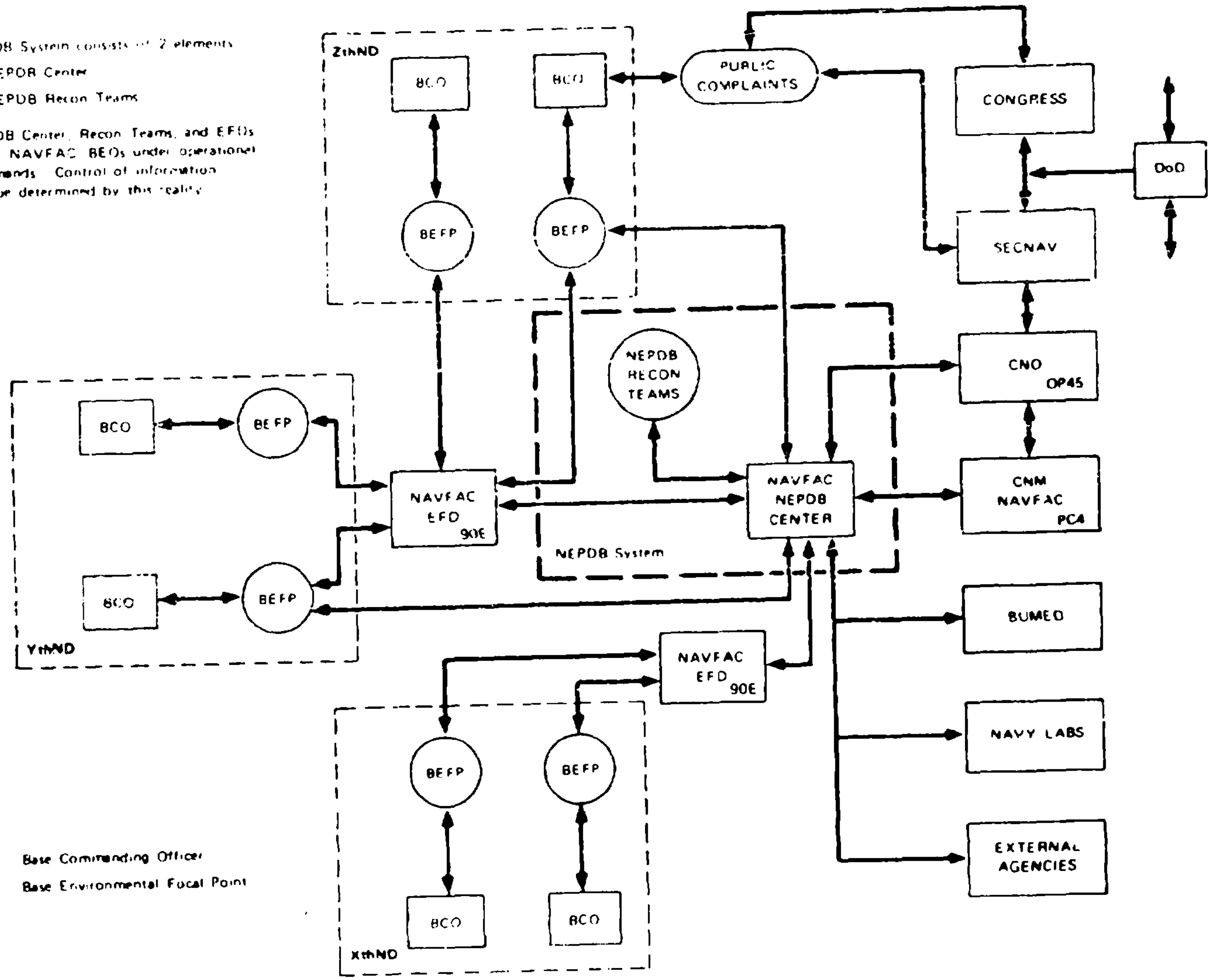
2 NEPDB Center, Recon Teams, and EFDs under NAVFAC, BEOs under operational commands. Control of information will be determined by this reality

BCO Base Commanding Officer

BEFP Base Environmental Focal Point

FIGURE 28 NEPDB SYSTEM CANDIDATE CONFIGURATION 2

1. NEPDB System consists of 2 elements
   - NEPDB Center
   - NEPDB Recon Teams
2. NEPDB Center, Recon Teams, and EFDs under NAVFAC. BEOs under operational commands. Control of information will be determined by this reality.



BCO Base Commanding Officer
BEFP Base Environmental Focal Point

FIGURE 29 NEPDB SYSTEM CANDIDATE CONFIGURATION 3

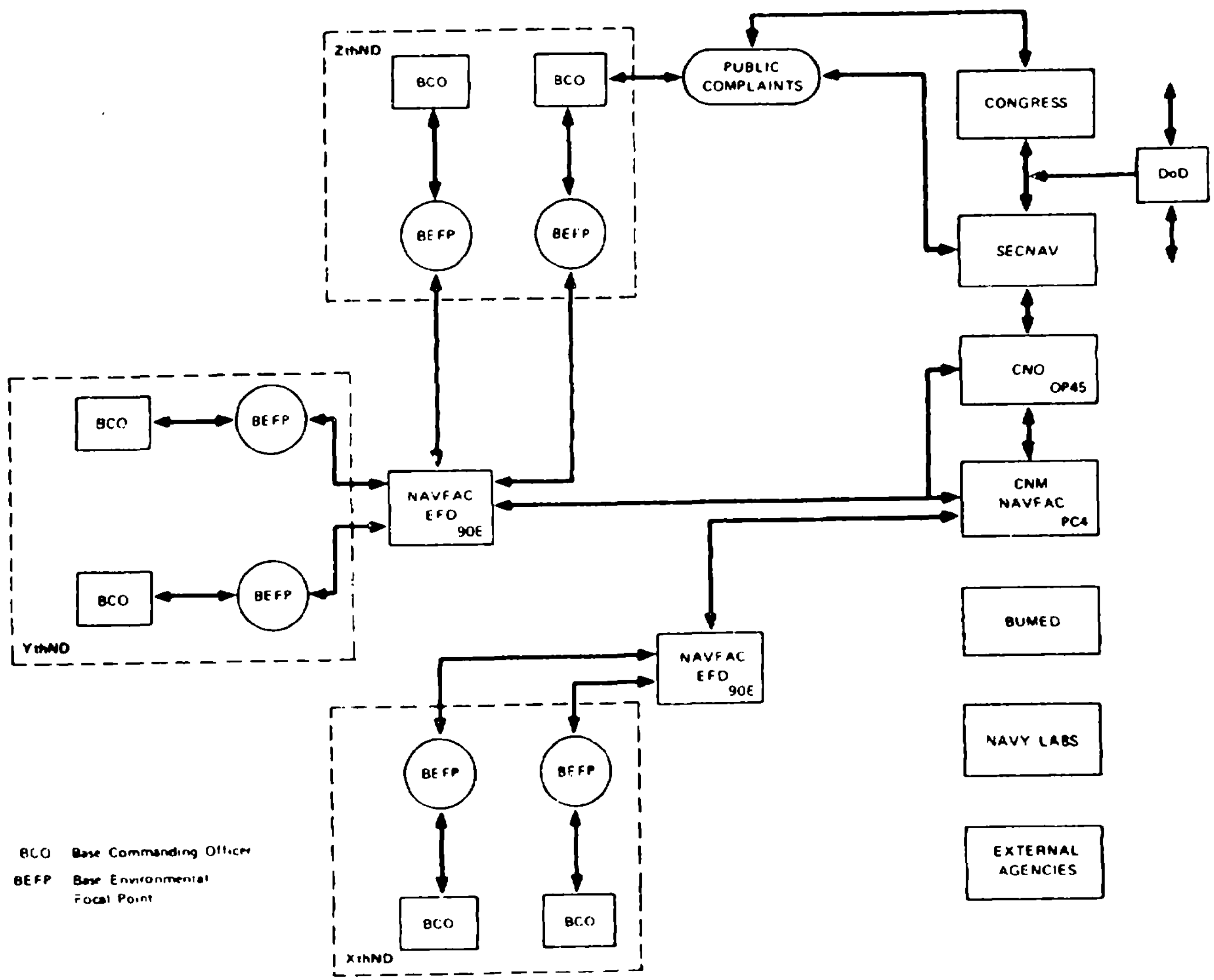


FIGURE 30 ABSENCE OF NEPDB SYSTEM: CANDIDATE CONFIGURATION 4

generation of indices were not considered infeasible nor rated grossly below the computer generation technique.

The addition of microfilm working storage was rated high in all the evaluation criteria mentioned directly above, but the uncertainty of user satisfaction with microfilm working storage was considered to outweigh the advantages obtained. However, this capability is strongly recommended for consideration for the growth stage following the initial NEPDB system implementation.

3. Storage Media

Storage media alternatives were analyzed in detail, and the trade-off analyses employed these alternatives in the system operations portion. After the system configuration and system operations analyses, the basic elements of storage media were basically fixed. The remaining conclusions reached in this area were that:

(1) Microfilm will be used for archive storage.

(2) Microfilm media, having been made available for use with archive records, will be used as appropriate to store voluminous, nonvolatile working data.

(3) The capabilities of microfilm with hard copy capability will be considered in the preliminary detailed design as a medium for temporary working data records and as a mechanism for disseminating more voluminous archive material.

The idea of supplanting the System 2000 data management system with another of enhanced capability was considered, but conclusions reached about manual/automatic operations caused the project team to delay further consideration until the preliminary detailed system design.

The results of the above synthesis are shown in Table 23, which gives four options. Portions of these options have been discussed above, and the system recommended is Option 2. Options 1 and 3 are both attractive and Section I, Summary and Conclusion, describes in more detail why Option 2 is preferred. Option 4 is not preferred because of the assumption of data sensitivity problems at the Navy bases. (This is also discussed in more detail in Section I.)

B. Comparison of the "Null" System and the Recommended NEPDB System

The information-handling aspects of current environmental activities are referred to for convenience as the "null" system, or the starting point against which any proposed system should be measured. Figure 30 shows the existing communication channels. This system might be characterized as follows: decentralized data storage, nonstandardized format and procedures, minimal index aids, passive response capability, and relatively noncoordinated interactions.

1. Decentralized Data Storage

Data collected as a result of monitoring efforts are retained at the local installation or at the associated EFD. In most cases there is no central repository for data collected at a variety of installations.

2. Nonstandardized Format and Procedures

Data are recorded in a format that is developed at a local level, are stored in a medium and location chosen at a local level, and are retained for a period of time selected locally. Data collection

Table 23

SUMMARY OF FINAL OPTIONS OF INITIAL SYSTEM

Option	Data Location	Operations				
	Central Data Base with Navy Bases Storing Their Collected Data	Manual Processing in General; Limited Computer Capabilities at NCEL	Manually Generated Indices*	Computer Generated Indices*	Microfilm Working Storage	Microfilm Archive Storage
1	X	X	X			X
2	X	X		X		X
3	X	X		X	X	X
4	For initial phase only with procedures to transfer to Central Data Base after security features are proven	X		X		X

* Indices provide locations of standards, pollution control authorities, Naval elements, facilities inventory, data sets containing measured parameters, etc.

procedures and sampling rates are also determined at the local level or to meet immediate requirements, e.g., to satisfy legal requirements at a particular installation.

3. Minimal Index Aids

Data stored locally are generally accessed only by the individuals responsible for their collection, storage, and use. Hence, there is little practical need for indices to assist in the retrieval of particular data. Since there is also little need to service requests from other installations or departments, the contents of data collected at one location are infrequently make known to those in other locations.

4. Passive Response Capability

There is no current procedure for data being collected to initiate reports or for actions based on the contents of those data. Reports or other information responses occur only when explicitly requested.

5. Noncoordinated Interactions

Although there are Navy coordinating agencies (OP-45, PC-4, Code 90E) for environmental problems that disseminate as much information as possible in the performance of their myriad duties, there is no formal procedure for the sharing of information among different organizational units. For example, a successful emission control technique may never come to the attention of a group other than the one first using it, or personnel requiring information derived from the data collection efforts

of several installations may have no convenient way of assembling that information.

Under the proposed NEPDB system, centralized data, specialized personnel, and standard formats, media, and procedures should all enable the staff at the central facility to process requests more efficiently than is now possible. But many requests pertaining only to a local situation will still be addressed to and answered by local personnel. However, these same standardized formats and procedures will significantly assist the local personnel to be effective in their own activities. It is expected that EFD personnel will spend less time servicing requests than under the null system, but increased system usage may obscure this result.

Another major result of the proposed system is the increased ability to foresee developing problems, as well as to report historical data. This will result from the event-triggered and time-triggered responses discussed in Section IX. In addition, specialized personnel who are constantly receiving data from all sections of the country will be able to identify regional or local differences that are not clear to those without as wide a perspective. These centralized personnel will likewise be able to disseminate uniformly reports of new techniques, solutions, and potential problems because of their ability to observe a wider range of activities. In summary, the NEPDB system will provide

valuable service to users and valuable information for local Naval personnel.

C. Recommendations for System Phasing for Growth

Previous sections have discussed the design of the initial NEPDB system to be implemented by 1 July 1973. Since SRI made the basic assumption that the system must maintain orderly growth, system phasing had to be developed. Initial considerations on this phasing are outlined in this subsection.

Many options are open for improving and extending the initial system design:

(1) Addition of microfilm working storage capability.

(2) Enhancement and/or extension of the present NCEL computer capabilities.

(3) Addition of further computer capability to automate some functions.

(4) Use of a more flexible data management software package than the System 2000.

(5) Mixtures or combinations of any of the above four options.

It should be noted that some of these options may or may not be feasible or cost-effective. Therefore, SRI recommends that further studies, simulations, or trial implementations be performed during either the period of initial system implementation/testing or the period of initial system checkout. Any one of these procedures would be convenient because of the complexity of augmenting the system and the uncertainty of the augmentation cost-effectiveness.

SRI believes that the options are preferable in the order in which they are listed. In particular, the microfilm working storage concept is sufficiently attractive to warrant close examination.

The concept of microfilm working storage can be tested with a rather small investment of both time and money. It would be advisable to select a particular file for conversion to the microfilm medium. This file should have enough reference activity for the working storage concept to be tested fairly over a period of a few months. It would also be best to select a file that is either well indexed or self-indexed, such as an alphabetical or numerical listing of some particular material. If such a file of some 10,000 pages were selected, it could be converted to microfiche by a service bureau for about $400. When the cost of a modest desk top reader (about $200) is added, the experiment can begin for an outlay of about $600.

There are two major features to be examined: the speed of the microfiche look-up operation and the psychological acceptance of the technique by users. The look-up speed could be benchmarked by comparing with either a parallel manual operation or with a previous manual operation. Regardless of the speed or potential speed, an adverse psychological reaction by users can more than offset any benefits. It is therefore important that careful attention be given to the ambient conditions such as chair height, lighting, and the like.

Further exposition of the above options is premature because of the lack of detailed information about the preliminary and final detailed NEPDB design phases. Therefore, it is recommended that further consideration of these options be carried out in Phase II.

D. Recommendations for Studies of Assumptions

A number of assumptions were made during the conceptual design period that significantly affected the final alternatives, the candidate system synthesis, and the choice of a recommended system option. It is believed that these assumptions should be examined and analyzed to obtain assurances that they are correct or that a modification of any assumption could lead to a modified system design and its enhancement. The assumptions that should be studied are:

(1) That data collected at a Navy base are sufficiently sensitive that they may not be released from that base's jurisdiction.

(2) That the data volumes estimated in this study are within reasonable limits, e.g., number of standards, number of measured parameters, and so on.

(3) That confidence and quality values can be or should be applied to received measured data at the NEPDB.

(4) That the priorities of user questions developed in this contract study are valid.

(5) That the frequency of system usage will support the system phasing described for handling growth.

(6) That microfilm working storage techniques will not readily be acceptable to NEPDB personnel, and thus the cost savings accrued thereby will not be attained.

(7) That the uncertain accuracy of measured environmental parameters and techniques can be accommodated in the system design by procedures that will satisfy users.

XV PRELIMINARY SYSTEM DESIGN PLAN FOR PHASE II

A. General

The Phase I effort on the NEPDB System Design activity has produced an overall design concept, which has as its base a manual system using automated preparation of indexing material. The concept permits the development of a system that has an excellent growth capability and is compatible with existing and planned data files. Phase I effort has also identified typical users of environmental data and the sources of such data, and has performed preliminary examinations of selected data parameters. Additionally, it has resulted in a general scheme for the specification of both central data files and other Naval base-located data files that are critical to the overall data base system operation.

Phase II of the program will be concerned with five specific tasks:

(1) Developing a preliminary detailed system design to meet the functional specifications of the NEPDB developed in Phase I. This design will include a capability for responding to five typical user questions, which have been described elsewhere.

(2) Performing technical and cost trade-off studies

(3) Testing and evaluating the preliminary system design against a set of definitive pass/fail criteria using the typical user questions.

(4) Developing technical approaches to and determining detailed costs for carrying the preliminary system design through the final design phase.

(5) Preparing a plan for completion of the final d[illegible] and implementation of the system.

This section of the report describes a proposed plan for the implementation of the Phase II effort.

B. Technical Approach

The Phase II effort will entail detailed consideration of six broad topics:

(1) NEPDB system functions

(2) Data base organization

(3) NEPDB data

(4) NEPDB system management

(5) System synthesis and testing

(6) Planning for final design and implementation phases.

In many respects the preliminary detailed design constitutes a continuation of the work performed to date. The conceptual design effort has considered the NEPDB system from a broad perspective to allow all viable alternatives to receive consideration. When all but the most promising of these alternatives have been eliminated, the scope of the investigation is narrowed and greater depth and levels of detail are made possible.

Each of the six topics is considered individually below.

1. NEPDB System Functions

The conceptual design has identified and described six major data base system functions in addition to input and output channels. These functions and their relationships are discussed in Section IX and their interrelationships are illustrated by means of generalized flow graphs. The manner in which these functions will be performed to satisfy

particular user requirements is also shown through flow graphs. As a final example in Section IX, a highly detailed flow graph was shown. In Figures 31, 32, and 33, an expanded set of charts is shown for four activities associated with the incorporation of new data into the data base system: initial reception and control; scheduling, allocation, data validation, and deficiency assessment; and data storage. These detailed flow charts identify each step to be performed in the process, specific data pertaining to each step, and files and data assemblies accessed. For each step, specific personnel assignments are identified. Also, actions and data flows associated with exceptional cases are identified.

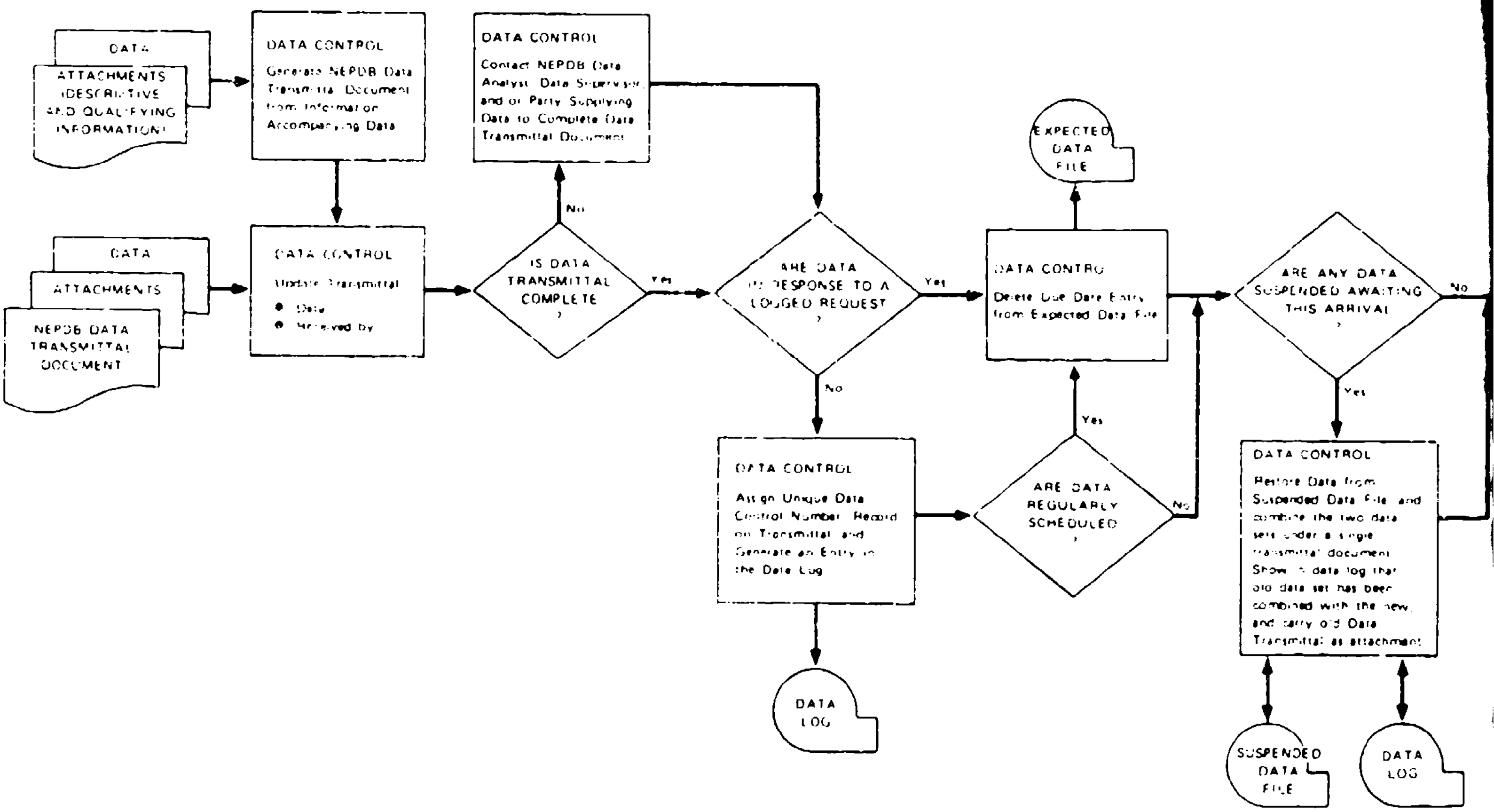
This last item is very important. In specifying the system it is necessary not only to meet the demands of users the system is intended to satisfy, but also to provide means for dealing with exceptional cases that might otherwise cause the system to break down or become non-responsive. Indeed, during a conceptual design the system resources and capabilities required to satisfy the typical user should be identified as freely as possible. It is the purpose of the detailed design stages to identify the atypical cases and augment the system resources, capabilities, and procedures to allow such cases to be accomodated. The allocation of effort to such atypical cases must be based on estimates of their frequency of occurrence. Such special cases generally require too detailed an analysis to be justified during the conceptual stage.

The major task relating NEPDB system functions during the Phase II effort will be to complete the development of functional specification to the level illustrated in Figures 31, 32, and 33. Each step in the procedure will be assigned a processing time derived through simulation or scenarios as necessary. The completed procedural and data flows with associated processing times will allow full specification of system support data (transaction logs, suspended transaction files, and the like), personnel requirements (both qualifications and levels of effort for given transaction volumes), forms and procedures necessary to support system operation (data transmittal forms, report request forms, tickler file maintenance for time-triggered actions), report requirements and formats, and so forth. This effort in turn will allow quantification of total system resources and costs and resolution of second-level trade-offs (manual versus automatic system accounting procedures) before recommendation of a final system functional configuration.

The proof of this detailed design will be the test and evaluation against the set of pass/fail criteria using the typical user questions. It is also intended that a set of atypical user demands will be "played" against the system to allow an assessment of its ability to handle special, infrequently occurring cases.

2. Data Base Organization

Basically, the design, organization, content, and medium for each data file will be specified in detail. Requirements for the


DATA
ATTACHMENTS (DESCRIPTIVE AND QUALIFYING INFORMATION)
DATA CONTROL
Generate NEPDB Data Transmittal Document from Information Accompanying Data
DATA CONTROL
Contact NEPDB Data Analyst, Data Supervisor, and or Party Supplying Data to Complete Data Transmittal Document
DATA
ATTACHMENTS
NEPDB DATA TRANSMITTAL DOCUMENT
DATA CONTROL
Update Transmittal
Date
Received by
IS DATA TRANSMITTAL COMPLETE ?
No
Yes
ARE DATA IN RESPONSE TO A LOGGED REQUEST ?
Yes
No
EXPECTED DATA FILE
DATA CONTROL
Delete Due Date Entry from Expected Data File
DATA CONTROL
Assign Unique Data Control Number, Record on Transmittal, and Generate an Entry in the Data Log
DATA LOG
ARE DATA REGULARLY SCHEDULED ?
Yes
No
ARE ANY DATA SUSPENDED AWAITING THIS ARRIVAL ?
No
Yes
DATA CONTROL
Restore Data from Suspended Data File and combine the two data sets under a single transmittal document. Show in data log that old data set has been combined with the new, and carry old Data Transmittal as attachment
SUSPENDED DATA FILE
DATA LOG

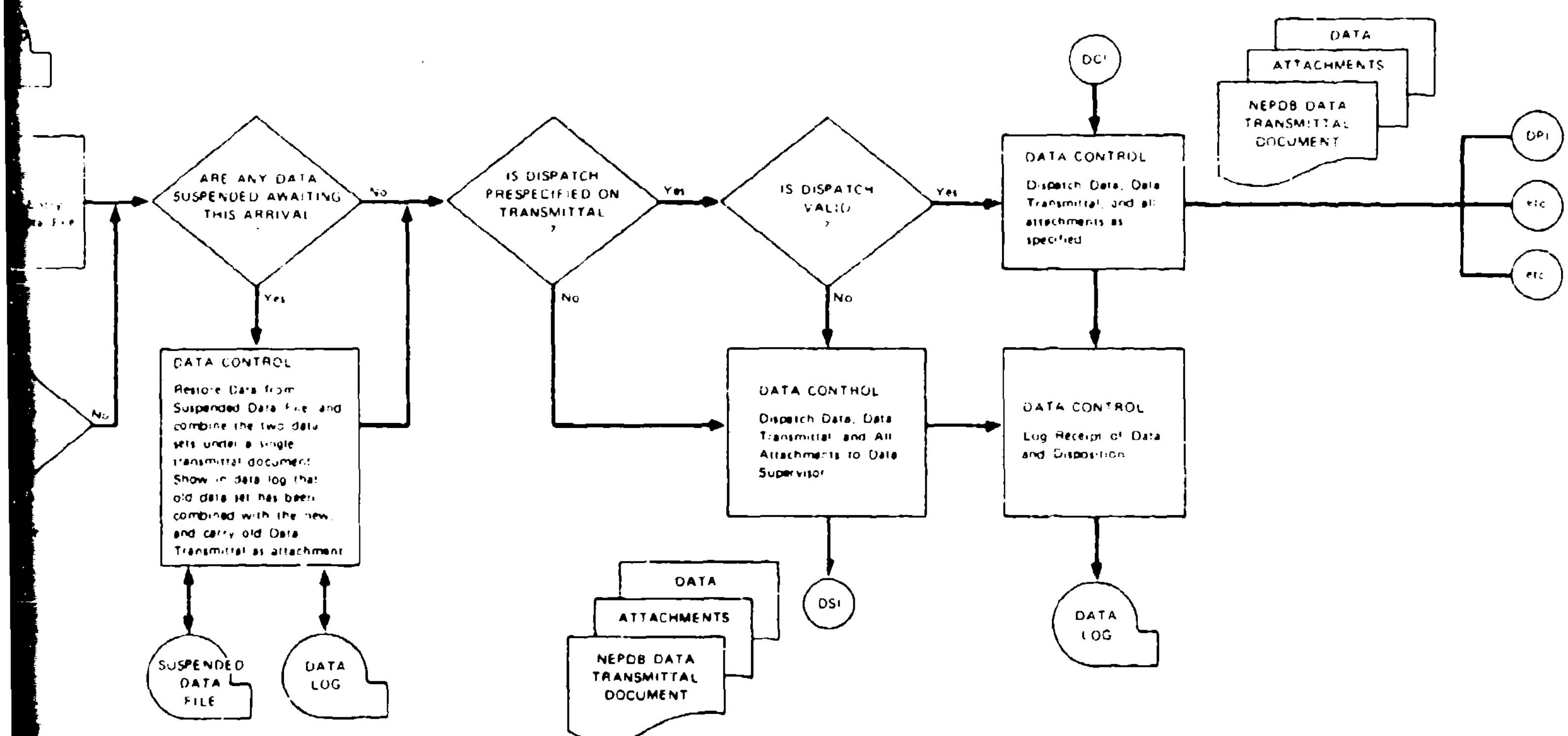
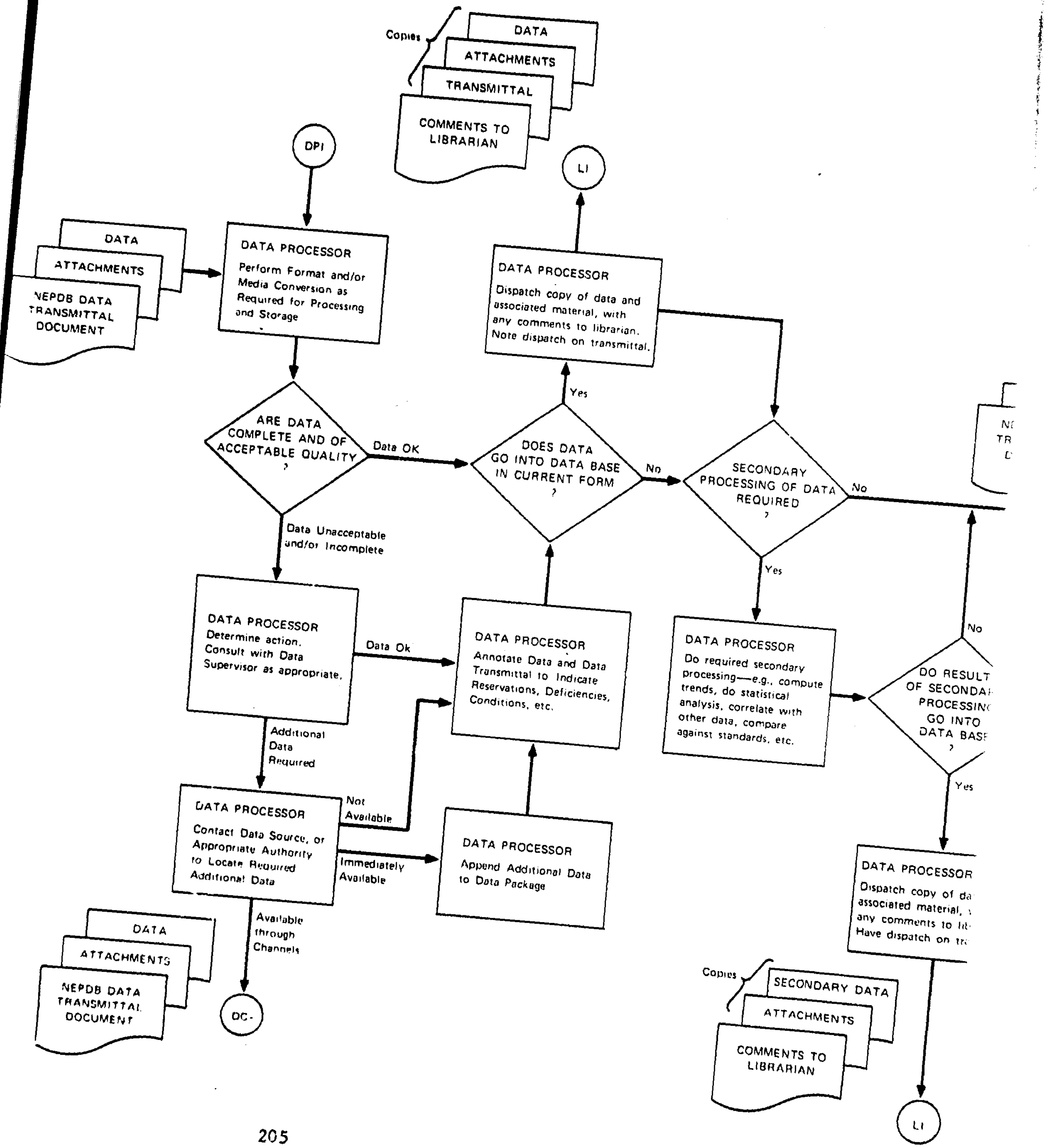
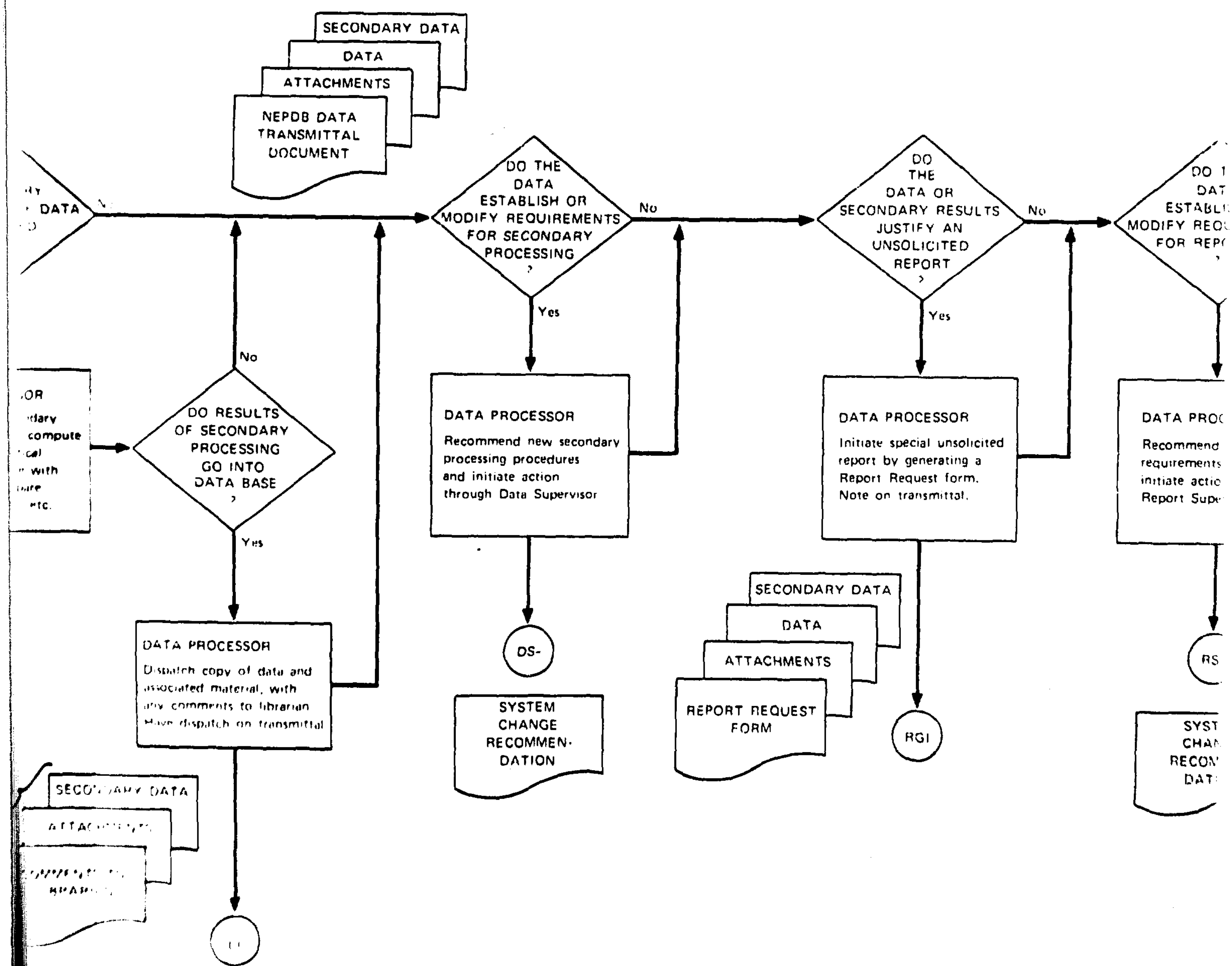


FIGURE 31 RECEPTION AND CONTROL FUNCTION: NEW DATA RECEIPT (LOG-IN) DISPATCHING SUB-FUNCTIONS


Copies
DATA
ATTACHMENTS
TRANSMITTAL
COMMENTS TO LIBRARIAN
DPI
LI
DATA
ATTACHMENTS
NEPDB DATA TRANSMITTAL DOCUMENT
DATA PROCESSOR
Perform Format and/or Media Conversion as Required for Processing and Storage
DATA PROCESSOR
Dispatch copy of data and associated material, with any comments to librarian. Note dispatch on transmittal.
Yes
ARE DATA COMPLETE AND OF ACCEPTABLE QUALITY ?
Data OK
DOES DATA GO INTO DATA BASE IN CURRENT FORM ?
No
SECONDARY PROCESSING OF DATA REQUIRED ?
No
Data Unacceptable and/or Incomplete
Yes
DATA PROCESSOR
Determine action. Consult with Data Supervisor as appropriate.
Data Ok
DATA PROCESSOR
Annotate Data and Data Transmittal to Indicate Reservations, Deficiencies, Conditions, etc.
DATA PROCESSOR
Do required secondary processing—e.g., compute trends, do statistical analysis, correlate with other data, compare against standards, etc.
No
Additional Data Required
DATA PROCESSOR
Contact Data Source, or Appropriate Authority to Locate Required Additional Data
Not Available
Immediately Available
DATA PROCESSOR
Append Additional Data to Data Package
Yes
Available through Channels
DATA
ATTACHMENTS
NEPDB DATA TRANSMITTAL DOCUMENT
DC-
Copies
SECONDARY DATA
ATTACHMENTS
COMMENTS TO LIBRARIAN
LI



SECONDARY DATA
DATA
ATTACHMENTS
NEPDB DATA TRANSMITTAL DOCUMENT
DATA
No
DO THE DATA ESTABLISH OR MODIFY REQUIREMENTS FOR SECONDARY PROCESSING ?
No
Yes
DO THE DATA OR SECONDARY RESULTS JUSTIFY AN UNSOLICITED REPORT ?
No
Yes
No
DO RESULTS OF SECONDARY PROCESSING GO INTO DATA BASE ?
Yes
compute
with
etc.
DATA PROCESSOR
Recommend new secondary processing procedures and initiate action through Data Supervisor
DATA PROCESSOR
Initiate special unsolicited report by generating a Report Request form. Note on transmittal.
DATA PROCESSOR
Dispatch copy of data and associated material, with any comments to librarian
DS-
SYSTEM CHANGE RECOMMEN- DATION
SECONDARY DATA
DATA
ATTACHMENTS
REPORT REQUEST FORM
RGI

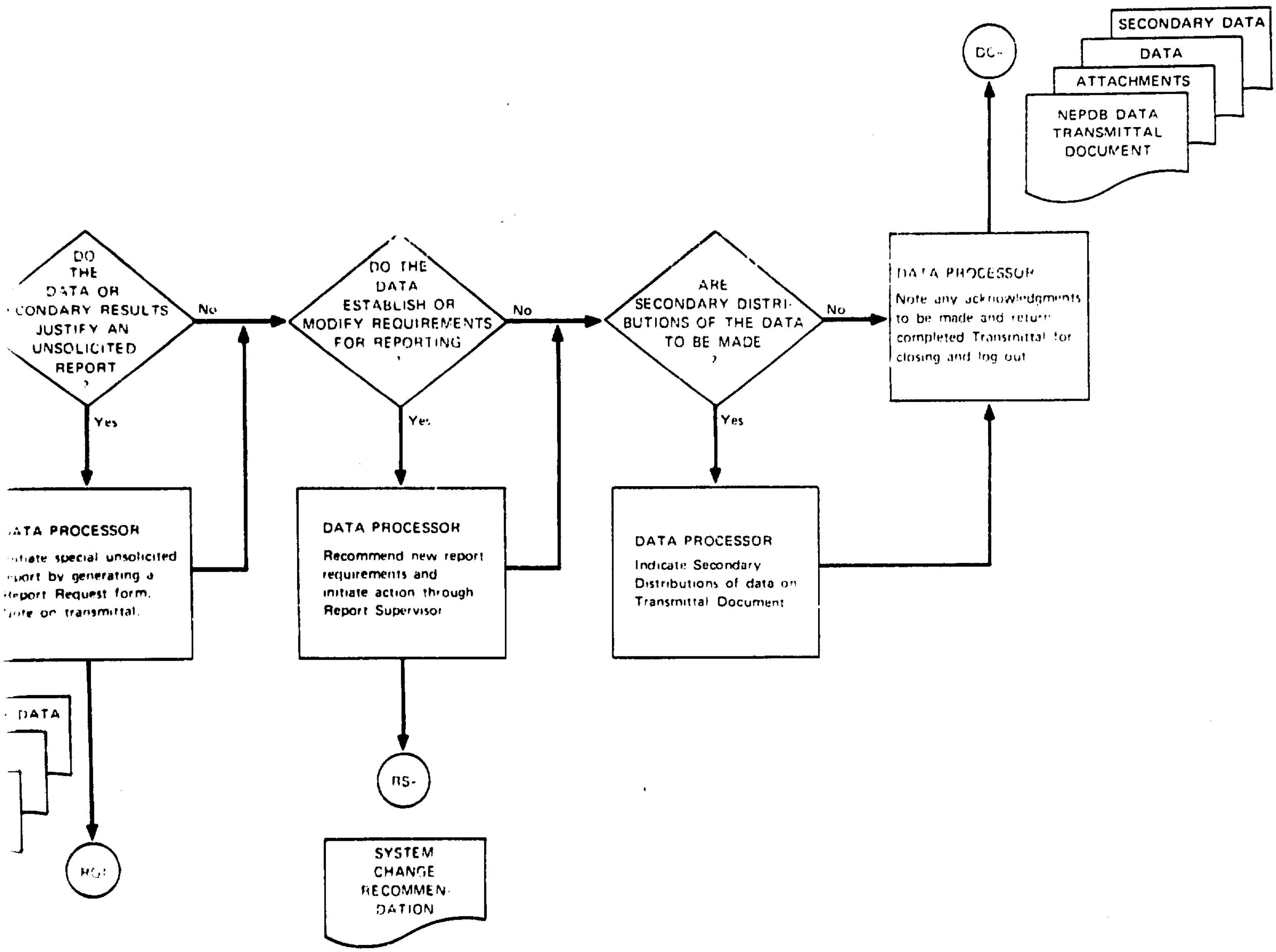
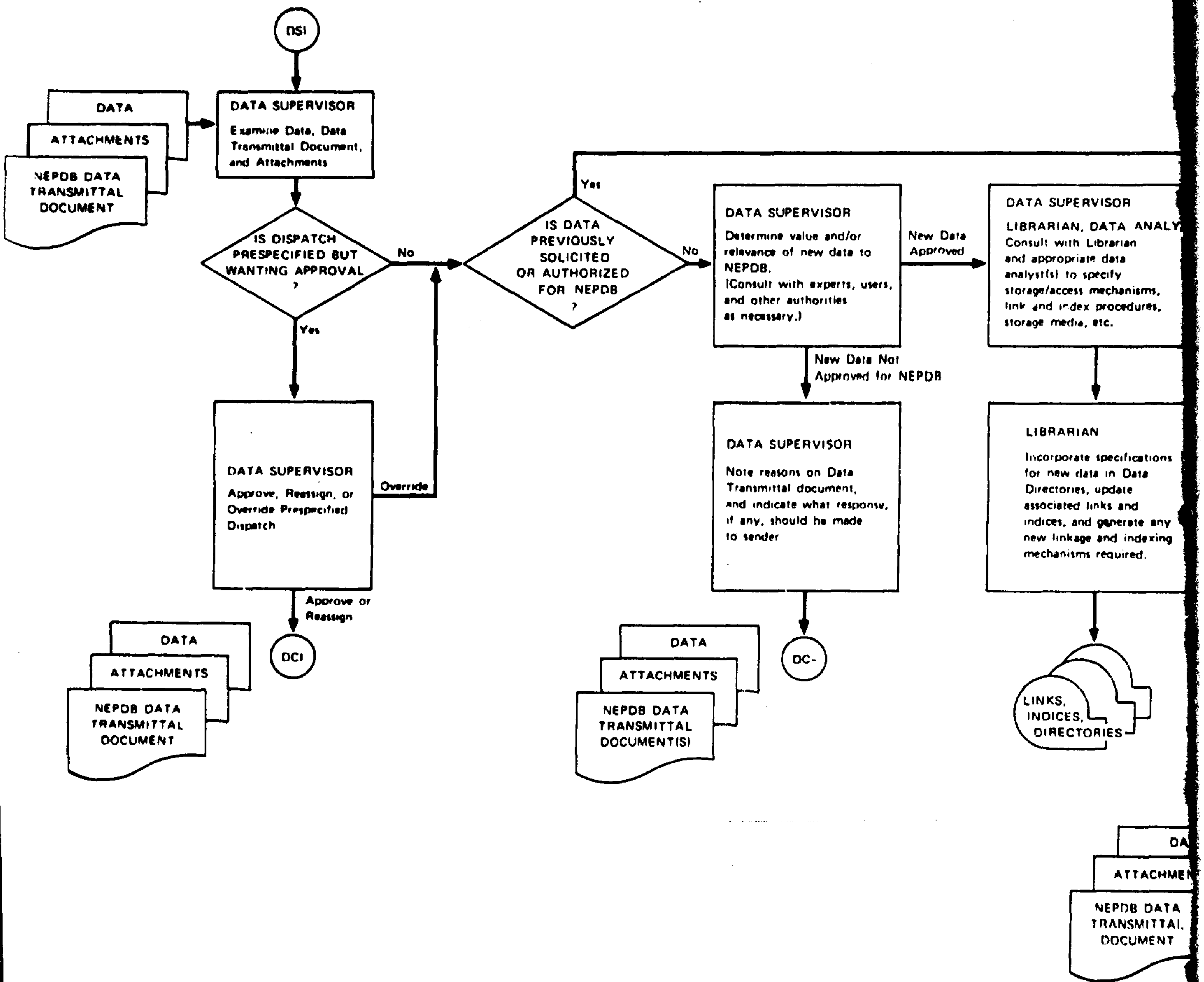


FIGURE 32 NEW DATA HANDLING: RECEPTION AND CONTROL

DATA SUPERVISION



"PRECEDING PAGE BLANK-NOT FILMED."

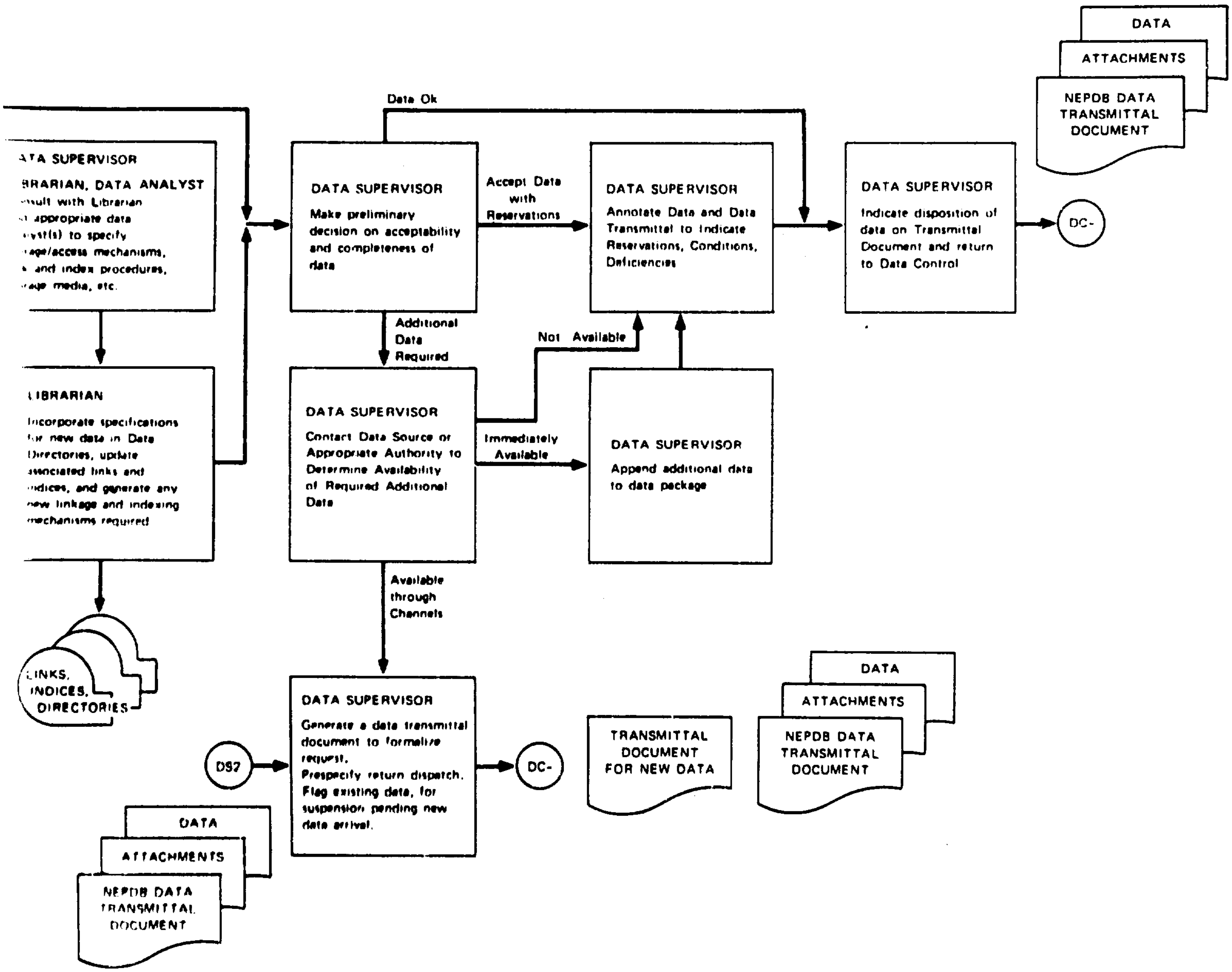


FIGURE 33 NEW DATA HANDLING: SCHEDULING AND ALLOCATION

maintenance and updating of each file and the frequency of updating and maintenance will be determined. Physical media required for storage will be considered and the form of the indexing scheme will be developed.

Procedures for the maintenance and updating of each file will be specified in the same level of detail as the operational NEPDB system functions. This is to allow a quantification of costs, assessment of resource and personnel requirements, and evaluation of the procedures to respond to both typical and special cases.

The conceptual design has identified 15 data categories and the fundamental data elements to be contained in each category. These categories are candidates for NEPDB system files. Of these categories, 12 have also been identified as potential indexing dimensions. The categorization and specification of category and data file contents will be refined during the Phase II effort. This refinement will be accomplished by the same methods used in the conceptual design: the further, detailed analysis of user requirements and priorities and the manner in which the data organization acts to satisfy those requirements. The EEF serves as a means to cross-check and validate the results of the requirements analysis. In addition, as described in Section X and in the trade-off analysis, an inventory of available Navy and non-Navy data bases will be made to identify the constituting resources that can be exploited in the generation and subsequent maintenance of the indices to the data base and the data base itself. The inventory will serve as the basis for

establishing a framework for data base and index organization, as described in Section X. This framework is a prerequisite to final evaluation of manual versus automated index generation trade-offs and costs to be completed during Phase II.

3. NEPDB Data

General classes of environmental data, data sources, and potential users have been identified, and preliminary examinations of significant data parameters have been made. In Phase II detailed examinations of all parameters will be completed. There are a number of important objectives to be satisfied. The assumptions made during the conceptual design will be validated to obtain an accurate assessment of data volume for each of the files. The inventory of Navy and non-Navy data bases used in designing the data organization will also be used here to assess potential data sources and data categories and to determine data acquisition costs and time delays.

System requirements for filing techniques and data development will be determined and the potential locations for data repositories will be identified.

Procedures and formats will be established for all data. Particular attention will be given to data collected and/or stored at decentralized locations. Such procedures, reporting formats, and reporting schedules must be established during the preliminary detailed design to ensure the degrees of coordination, control, and accessibility

required to achieve desired NEPDB system performance levels. Most important, procedures for determining and expressing confidence levels and tolerances in collected data will be developed.

4. NEPDB System Management

The preceding task areas have focused on pursuing in depth the subjects addressed in the conceptual design. To fulfill the overall system objectives and to provide for all those support functions and data elements necessary for effective system management and growth, this task will consider in particular the topics of total NEPDB system management; provisions for system growth, expansion, and adaptability; computer and software systems; support hardware (such as microfilm); and related topics. Attention will be given to specialized system functions necessary to support effective management and to handle atypical demands on the system. It will serve as a means of coordinating the other Phase II efforts from a total system point of view.

For example, part of this task will be the examination of existing, available computer facilities and analysis of their potential use in the NEPDB system. Appropriate facilities for the data base system will be recommended. Available software packages will be studied to determine the feasibility of employing such packages in the system design, the manner in which the packages could be used, and the costs associated with such use.

5. System Synthesis and Testing

This is the final task during which all results from the first four Phase II tasks will be integrated into their final form as a preliminary, detailed design for a total NEPDB system. The integrated system design will be subjected to acceptance tests, improved to optimize performance as measured by those tests, and will then be the subject of a final, comprehensive report. This integrated design will form the basis for the planning of the final design and implementation efforts.

6. Planning for Final Design and Implementation Phases

The final major task for Phase II will be the generation of a plan for final design of the NEPDB system and subsequent implementation. This plan will include expected implementation and operational costs for the system configuration whose detailed specification is the product of the Phase II efforts. Certain secondary options will remain at this point, and the trade-offs associated with each such option will be described in full.

It is noted here that a more productive approach, in terms of both time and resources, would be to combine the Phase II and Phase III efforts into a single effort. Review periods during the project would allow efforts to be redirected as appropriate and "buy-off" points could be established for the total project schedule.

A significant part of the Phase II effort is the formal preparation for the Phase III effort. This additional effort constitutes the

bulk of the effort that could be redirected. A factor to be considered is that effort in each of the first four tasks is suspended for some time between completion in Phase II and reinitiation in Phase III. This interim delay results in a loss of momentum for the continuing contractor.

Thus, although SRI would willingly conduct the remaining research according to the plan initially specified for the data base system, it is believed that the potential of a more productive effort suggests consideration of combining Phases II and III for the next stage of the work.

C. Management Plan

1. Personnel and Organization

SRI personnel who contributed to this study have gained particular insight into the nature and background of the proposed Navy NEPDB system. So that this insight and experience will not be lost to the preliminary design effort, it is proposed that these same individuals form the nucleus of the research team for this next phase, Phase II. The project leader will ontinue to be Mr. David N. Berg.

The personnel who will work on the preliminary design will be drawn largely from the Systems Planning Department. Other departments that will be represented include the Operations Evaluation Department and the Information Systems Group. The skills and background of SRI personnel in these and other departments will be used as the occasion may require.

2. Navy Interface

The project team found it very helpful to talk to various Navy personnel at NCEL, the Western Naval District EFD, at local bases, at PC-4, and at OP-45. During the preliminary design phase, more attention will be given to details of the system operation and implementation. SRI feels that it is very important not only to continue these contacts but to expand them. In particular, it will be necessary to communicate with representatives of other EFDs and operations to ensure that a narrow or unrealistic detailed design does not result from the study.

SRI will continue to look to NCEL for guidance and liaison with other Navy contacts.

3. Project Control

As each project milestone is reached, the work will be reviewed by the project supervisor, Mr. Arthur C. Christman, Jr. Periodic status reports will be submitted to NCEL after 30 and 60 days, with a final draft report submitted 90 days after the project begins. Since the progress reporting sessions conducted during the present study were found to be helpful, it is hoped that a similar format will be followed in the proposed phase in connection with each status report.

4. Schedules of Work and Reports

A proposed work schedule for Phase II is shown in Figure 34. In addition to the periodic status reports, a draft report of the plan,

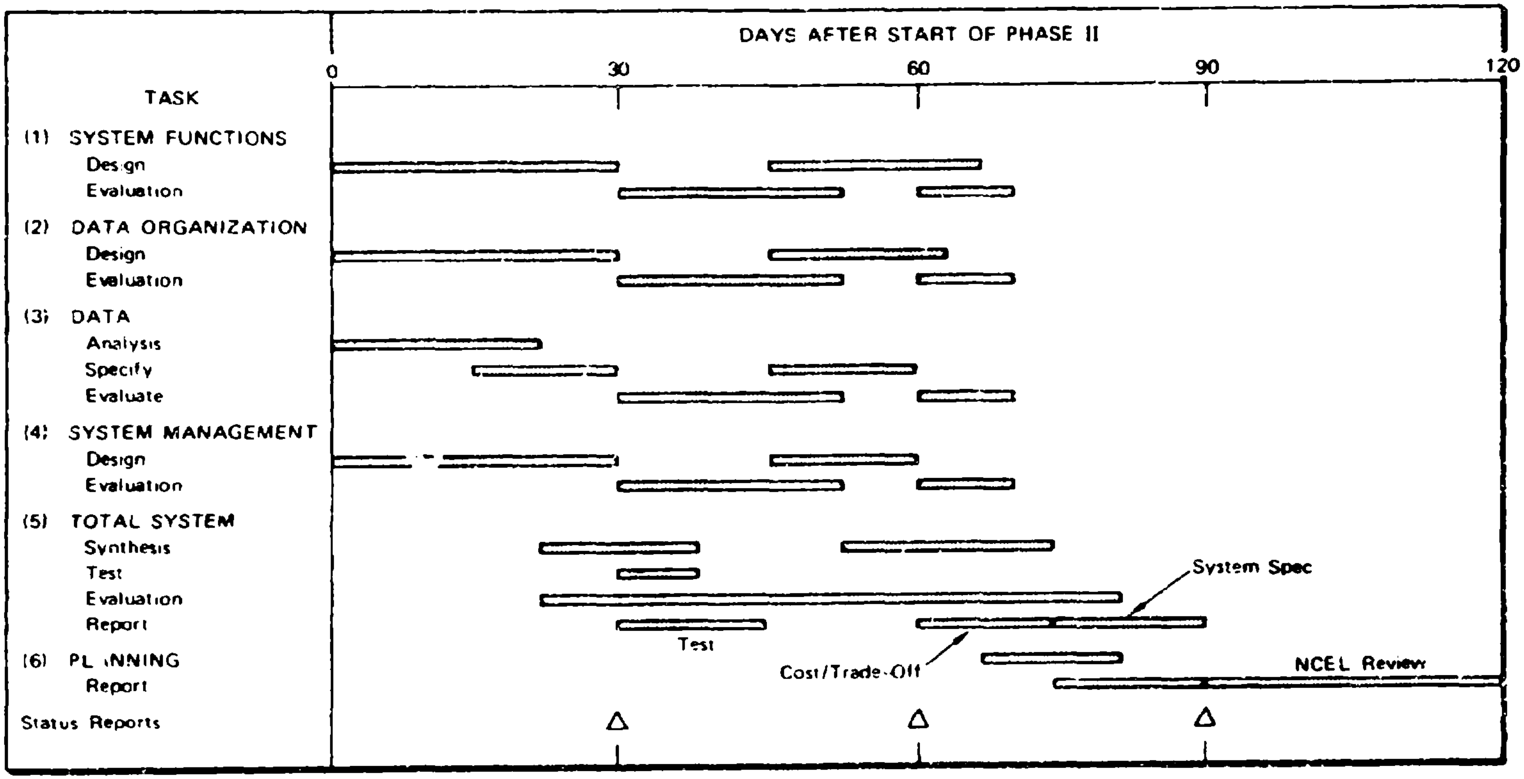


FIGURE 34 SCHEDULE FOR NEPDB PHASE II

test, and evaluation task will be submitted 45 days after the start of the project. A draft report of the technical and cost trade-offs will be submitted 75 days after the start of Phase II.

D. Implementation and Operational Cost Estimates

1. Introduction

In the 28 June 1972 letter to SRI from NCEL, additional data on the development and operating costs and a list of studies to be performed to validate the design of the NEPDB system described in the SRI Draft Final Report "Conceptual Definition of the NEPDB System," Contract N62399-72-C-0006, were requested.*

In response to this request SRI has generated preliminary schedules, summary task definitions for the NEPDB implementation, and estimated manpower needs for the implementation tasks required to meet the preliminary schedules. Additionally, SRI has estimated the initial manpower required to operate the NEPDB system beginning in July 1973 and has augmented the assumptions to be studied listed in Section XIV-D. The manpower requirements described above can be used to develop costs for implementation and operation of the initial NEPDB system.

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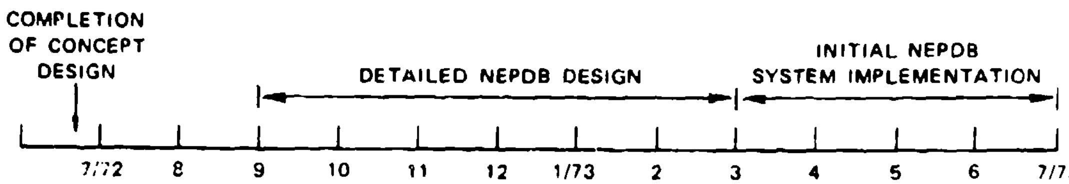
* This subsection was originally sent to NCEL as "An Addendum to SRI's NEPDB Concept Definition." According to instructions of NCEL, it has been incorporated into Section XV of the final report.

The manpower required to implement the SRI NEPDB concept design so that the NEPDB can be operational by July 1973 has been estimated on the basis of the following assumed schedule:



The development of the initial NEPDB system from the present concept requires a detailed design phase lasting about 6 months, as shown on the above schedule, as well as an implementation phase lasting from approximately March 1973 to July 1973. For completeness, the cost of SRI's effort on the detailed design is included here so that the full development cost can be assessed. The detailed design is estimated to range between $100,000 to $150,000.

2. Implementation Cost Estimates

The major portion of the implementation of the NEPDB lies in the data base organization, indexing, and data collection efforts. Some of these activities will be done in the detailed design phase and some in the implementation phase. Other significant efforts will occur in the testing, integration, documentation, and training areas. Table 24 lists the tasks that SRI considers as significant contributors to implementation costs.

Table 24

IMPLEMENTATION TASKS

Data organization tasks	
DO-1	Identification of existing resources
DO-2	Preliminary detailed designing of data base organization
DO-3	Preparation of glossaries, indexing frameworks and indexing standards and procedures
System function procedures	
SF-1	System function specification
SF-2	Procedures for function performance
SF-3	Manuals for system functions
Data base	
DB-1	Formats
DB-2	Procedures for conversion
DB-3	Confidence and tolerance levels procedures
System test	
ST-1	Request-handling test
ST-2	Data-handling test
ST-3	Deficiency assessment test
Implementation support	
IS-1	Training
IS-2	System documentation
IS-3	User guides

A preliminary tentative schedule showing estimated time periods during which the tasks shown in Table 24 would occur is given in Figure 35.

Each task area is described, and estimates of manpower requirements are given in the following pages.

a. Data Organization

Five NEPDB system design and implementation tasks are associated with establishing an organization for the data base and providing a means of indexing its contents:

Task DO-1 - Identification of existing resources.

Task DO-2 - Preliminary detailed designing of data base organization

Task DO-3 - Preparation of glossaries, indexing frameworks, and indexing standards and procedures.

Task DO-4 - Preparation of basic data indices and lists.

Task DO-5 - Generation of cross-referenced indices and catalogs.

These tasks have been described in the SRI report "Concept Definition of the NEPDB System." The first two tasks complete design efforts and allow detailed cost estimates to be generated. The remaining tasks accomplish the implementation of the data base organization. The tasks are described here for purposes of establishing initial cost estimates and schedules.

1) DO-1 - Identification of Existing and Required Resources

It is not necessary to begin from scratch in collecting and organizing data and indexing information for the NEPDB system. Much of the required information already exists in some form or another;

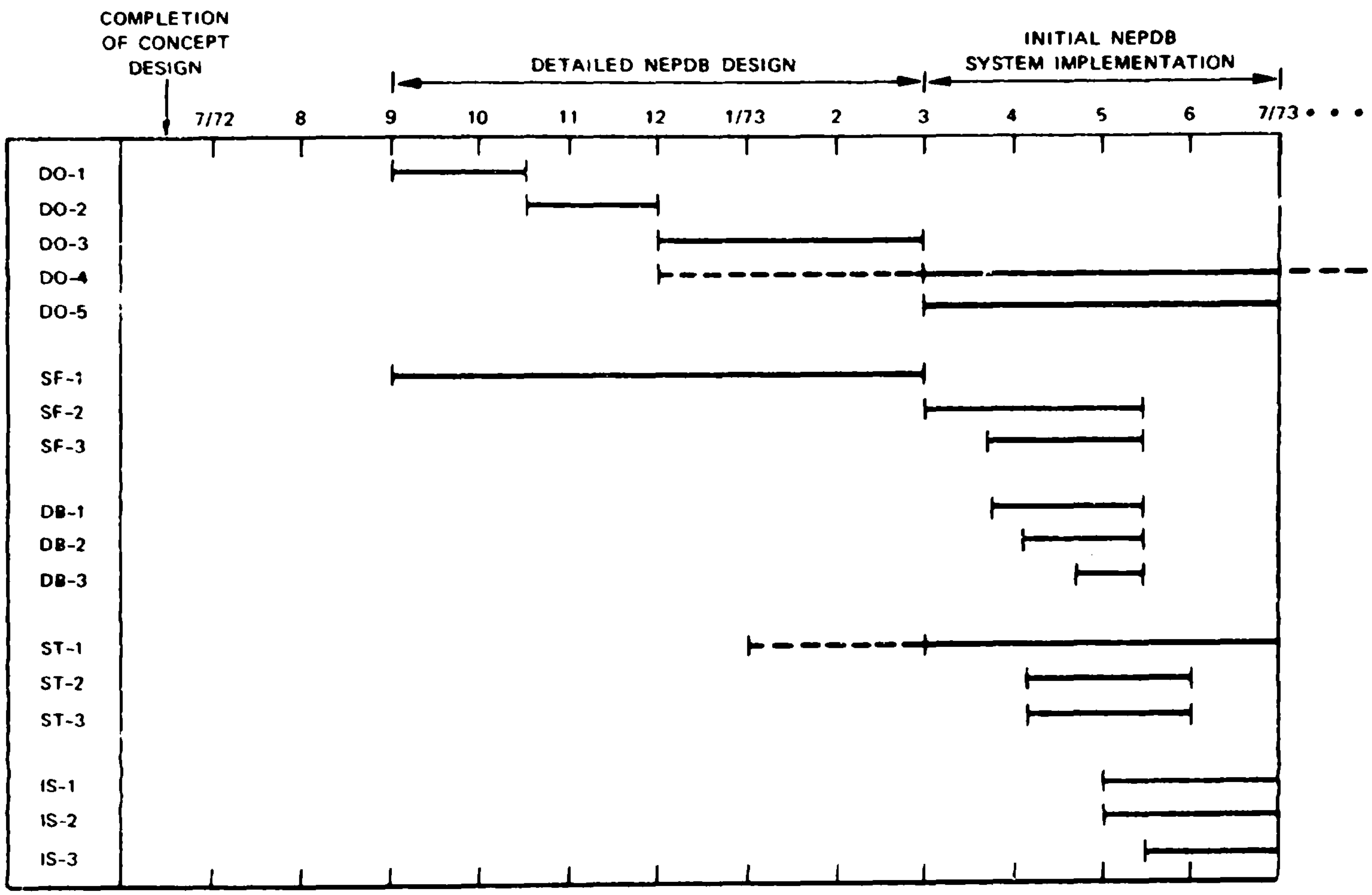


FIGURE 35 IMPLEMENTATION TASK SCHEDULE

much of the available information has been prepared or collected by the existing NEPDB staff. Catalogs of environmental standards, catalogs of environmental monitoring and instrumentation techniques and equipment, lists of pollutants, and the "Magic" file are examples of resources available at the existing NEPDB center.

Outside sources also exist. For example, from the STORET system can be obtained a list of measurable water quality parameters that is somewhat more comprehensive than that prepared by the NEPDB staff. The utility of this more comprehensive listing for the NEPDB system is questionable, but it deserves attention as a resource to be identified and evaluated.

The purposes of this task are primarily identification and quantification, to support task DO-2. Three objectives are to be satisfied:

(1) Identification of all existing data resources of potential utility to the NEPDB system.

(2) Identification of data having potential utility to the NEPDB system that are not currently available. Such data will have to be located, collected, or generated in subsequent implementation tasks.

(3) Determination of sizes (i.e., quantification) for all identified data resources, whether currently existing or to be generated.

This task is to be completed as a part of the detailed NEPDB system design.

2) DO-2 - Preliminary Detailed Designing of Data Base Organization

Working with the material collected in Task DO-1, the data base organization described in the SRI concept definition for the NEPDB system will be refined into a detailed design. The detailed design for the data base organization will include:

(1) Specification of all data categories and indexing dimensions.

(2) Specification of the content of each data category in terms of fundamental data elements to be included. A distinction will be made between primary (direct) data elements and secondary data elements included for purposes of linking and cross-referencing.

(3) Specification of the medium to be used for each of the data elements.

(4) A plan for implementation of the data base organization and procedures for subsequent maintenance.

(5) A set of refined cost estimates for each of the tasks identified in the implementation plan for the specified maintenance procedures.

This task is to be completed as a part of the detailed design effort.

Tasks DO-1 and DO-2 complete the work begun during concept definition and produce a fully documented and costed detailed design with plans for implementation and procedures for subsequent maintenance of an NEPDB organization. The remaining tasks are directed toward implementation of the data base organization.

3) DO-3 - Preparation of Glossaries, Indexing Frameworks, and Standards and Procedures

This task carries the work described above through the detailed design phase in anticipation of and preparation for actual system implementation. The following work is to be accomplished:

(1) Completion of final designs and establishment of record formats for all data files, data indices, and index catalogs included in the data base.

(2) Preparation of lists, catalogs, and glossaries to serve as a framework for indexing. A librarian will use a preestablished framework for each of the index catalogs that is maintained. For author and title catalogs the framework consists of a set of procedures. For subject catalogs the framework consists of a preestablished set of subject headings and cross references under which index entries may be filed. For the NEPDB system it is necessary to produce such frameworks for each of the indexing dimensions. Three basic cases exist:

- A set of procedures must be established. This will be the case in indexing environmental standards, where a method for assigning unique accession keys will have to be established (or selected from the several schemes used by the legal profession).

- A framework of acceptable indexing headings will have to be established to serve as a framework for indexing. If the data base is to be indexed by identification of a specific pollutant or environmental constituent, a list of all valid pollutant and environmental constituent names, with inversions, alternate spellings, and cross references must be prepared. This is comparable to generating a list of preestablished subject headings.

- An indexing framework already exists. This is the case with the "Magic" file and the facilities inventory. In this case the framework must be documented for use in preparing indices to the NEPDB system.

(3) Establishment of standards for indexing and written specifications for all index generation and maintenance procedures. In contrast to the standards and specifications produced in Task DO-2 for design purposes, these documents are to be in full detail and for use in training NEPDB system personnel. Following NEPDB system implementation, these documents will serve as operational handbooks to guide data base and index maintenance.

This task completes the detailed design and provides the tools required to begin implementation of the design for the data base organization.

4) <u>DO-4 - Preparation of Basic Data Indices and Lists</u>

This task encompasses the bulk of the implementation cost and effort. It implements and executes the procedures specified in the preceding steps and goes hand-in-hand with the data collection tasks; indeed, it is difficult to separate the efforts and costs of the two tasks.

Table 25 lists assumptions for each of the 12 data categories and indexing dimensions that must be processed as a part of this implementation task, and gives estimates of the effort required for each catefory. The effort is divided into two parts: data gathering and processing (analyst) and information capture and validation (clerical). For data gathering and processing, both maximum and expected efforts are estimated. In addition, the table shows the number of entries on which

Table 25

DATA BASE ORGANIZATION EFFORT

Data Category	Number of Entries (estimated)	Existing Basis	Additional Entries Needed	Expected Effort *	Maximum Effort *	Capture and Verify
Environmental Control Authorities	250	?	--	1	2	0.2
Environmental Control Standards	500	Yes	Yes	5	8	1.0
Geopolitical Locations	250	?	--	0.5	1	0.2
Naval Locations	160	Yes	No	3	5	0.5
Naval Organization	100	Yes	?	2	3	0.8
Naval Facilities	5000?	Yes	?	10	36(16)	5.0
Materials and Supplies	1500	?	?	2	6	1.0
Environmental Constituents	800	Yes	Yes	2	5	0.8
Parameter Monitoring Activities	100	No	--	1	3	1.0
Naval Directives	300	?	--	3	5	0.5
Monitoring and Instrumentation	800	Yes	Yes	2	5	0.5
Control and Abatement	200	?	--	2	5	0.5
				33.5	84.0	12.0

* Man-months

the estimates are based and indicates whether there is an existing basis of available information for the data category. The data categories are taken from the SRI design concept. Because this task demands so much effort, it is worthwhile to make some comment about certain of the estimates shown in the table.

a) Environmental Control Standards

Effort is currently being directed toward summarizing environmental control standards at the NEPDB center. To date, standards have been summarized for four Naval complexes, and work is proceeding on six more. The estimate is based on the current status of this work and the effort already expended.

Information for the Environmental Control Authority category should result as a by-product of this effort and require minimal additional resources.

b) Naval Locations

Much of the information required for this category is already contained in the "Magic" file and the FACSO facilities inventory. To these data must be added information about monitoring, instrumentation, abatement, and control activities at each of the locations, plus identification of personnel having local responsibility for environmental matters. The estimates assume that much of this information can be obtained through questionnaires and that only a few of the locations will have programs of any magnitude during the NEPDB system implementation

period. If field inspections are required to obtain the necessary information, the effort will be greatly increased.

Information for the Geopolitical Location and Naval Organization categories should result as a by-product of integrating the Naval Locations data into the data base.

c) Naval Facilities

This is the largest single category. The FACSO facilities inventory serves as an organizational framework for this category, but much of the required data remains to be collected. It is assumed that, of all Naval facilities included in the inventory, only a few will be of interest to the NEPDB. For these, two kinds of data require assembly: data about types of facilities and data about individual facilities at specific locations. The estimate of expected effort assumes that only data about types of facilities will be assembled. The estimate of maximum effort assumes that additional data about individual facilities at specific locations will be assembled. The estimates include provisions for integrating data currently being prepared elsewhere, e.g., data about ships and their emissions.

Note that data about individual facilities at specific locations will be required eventually, but these data can be assembled over a longer period of time--say, during the first two years of system operation--to reduce resource requirement peaking during the implementation period. If this is done, the maximum effort estimate should be reduced to 16 man-months.

d) Materials and Supplies

It is assumed that a basis for this category similar to the facilities inventory exists within the Navy. If it does not, other sources of these data must be located. One source is the assembly of operational characteristics descriptions for facilities, for which effort has already been allocated.

e) Environmental Constituents

The list of pollutants being prepared by the existing NEPDB staff is the basis for this category. The effort shown is for augmenting the data listed under each entry in this list. This is also the case with the Monitoring and Control categories.

f) Parameter Monitoring Activities

Effort for this category is that required to characterize data sets being collected during the period of NEPDB system implementation. This activity will eventually take larger proportions as the scope of monitoring and instrumentation programs increases throughout the Navy.

g) Naval Directives

The availability of catalogs and indices to Naval Directives and Instructions suitable for the NEPDB system is unknown. The effort shown assumes that such a basis exists but that additional information is required and will have to be extracted from 300 or so directives.

h) Summary

According to these assumptions, between 3 and 7 man-years of effort are required during implementation for purposes of data collection and organization (exclusive of the assembly of parameter measurement data sets). If data about individual facilities at specific locations are collected over a longer period of time, between 3 and 6 man-years of effort are required. In addition, approximately 1 man-year of data capture (keypunch), verification, and proofreading is required.

These assumptions require validation if the costs are to be accepted as a basis for funding. When the work described above for Tasks DO-1 and DO-2 is completed, considerably more accurate estimates can be made. The estimates given above are very sensitive to the manner in which data are categorized and assembled.

Because some of this information is being assembled by the existing NEPDB staff as a part of their current activities, the DO-4 task is shown in Figure 32 as beginning three months before the start of the implementation period.

5) DO-5 - Generation of Cross-Referenced Indices and Catalogs

This task is relatively straightforward if Task DO-4 is correctly specified and performed. Each of the lists and data assemblies captured in computer-readable form will be made into a computer file. Various groups of these files are then inverted and merged to

produce cross-reference linkages between the various files. The results may then be listed or put onto microfiche in the appropriate formats to produce the indices. It is estimated that 6 man-months of effort and approximately 100 hours of IBM 360/40 computer time (or its equivalent) will be required to complete this task. Thereafter, it is estimated that between 2 and 4 hours of IBM 360/40 computer time (or its equivalent) per week will be required to maintain the indices. Actual time will depend on volatility of the various data categories and the manner in which initial data capture is distributed over the implementation period and subsequent operational periods.

It is noted here that when Task DO-5 is completed, all data assembly, capture, and organization necessary to support an on-line data base indexing capability have been completed. It is required only to produce the on-line software to interrogate the data base index files and to acquire an on-line interactive capability (perhaps through a source of time-sharing services). It is estimated that approximately 6 man-months of programming time would be required to produce such an on-line capability, and this should be considered seriously as an early system enhancement following initial system implementation at the end of fiscal 1973. To consider such an enhanced capability before initial system implementation was completed would, in SRI's judgment, have the potential for jeopardizing implementation schedules.

b. System Functions

Six major system functions are specified in SRI's NEPDB system design. It is assumed that during the detailed design phase these six system functions will be described in flow charts to a level of detail that shows all related actions, but specifies operating personnel duties for each function, and that identifies the data and data files required to perform a function. Examples of the detail required are shown in Figures 31, 32, and 33. Following this effort a further breakdown of individual operations will be necessary in some cases; e.g., the performance of a statistical calculation on data may require the specification of an algorithm and/or a sequence of mathematical calculations. The definition of such operations will be made during the final NEPDB design phase. All major system functions will be detailed in the above manner.

The result of the above work during the detailed design phase will provide an extensive basis for the NEPDB system implementation. What remains for system function implementation is to formalize the procedures for function performance, document the system operation by use of manuals for each of the NEPDB personnel categories and produce user manuals. Included in the procedures for function performance are the priorities of request handling, schedules for cyclic/timed system events (deficiency assessment, report generation, and the like), scheduling and use of internal accounting data, and so on.

The effort to formalize functional performance procedures is estimated to take 2.5 man-months. Documenting the system operational aspects is estimated to take 1 man-month. The effort for development of user manuals is included in estimates for the overall system user guides generation section.

These tasks are shown in Figure 35 as:

Task SF-1 - System function specification

Task SF-2 - Procedures for function performance

Task SF-3 - Manuals for system functions.

c. Data Base

Three tasks associated with data base content are to be completed as a part of the NEPDB system implementation:

Task DB-1 - Formats

Task DB-2 - Procedures for conversion

Task DB-3 - Confidence and tolerance levels procedures.

These tasks have been described in the SRI report on the NEPDB system concept design. They are described here principally for purposes of estimating implementation costs and schedules.

The following discussions deal with the individual environmental parameter measurements that make up the environmental parameter data sets. The tasks associated with collecting and organizing other data, such as environmental standards, facility descriptions,

monitoring and instrumentation techniques, control and abatement technology, and others, have been described in the section on Data Base Organization.

1) <u>DB-1 - Formats</u>

The specification of record formats for each of the data categories selected for the final system design has already been described under tasks DO-2 and DO-3. It remains to specify report and data record formats for the environmental parameter measurements and associated data sets.

The SRI design concept includes within the scope of the NEPDB system a central location that is the repository for data, the EFDs, and all (or most) Naval locations at which environmental parameter measurements are made. Storage of raw environmental parameter measurement data is decentralized. Such data are kept either at the location at which the measurement was made or at the EFD within whose jurisdiction that location falls. Storage of summarized data is centralized. That is, periodically--weekly, biweekly, or monthly as appropriate--the raw data would be summarized and appended to the appropriate data set at the central NEPDB site. The major reason for including the individual Naval locations within the scope of the NEPDB system is to facilitate standardization and uniformity in the recording and reporting of environmental parameter measurement data at the widely scattered sites. It is the objective of this task to specify the uniform data

recording and reporting forms and media to be used in reporting these data, whether in raw or summarized form.

It is observed that a number of such forms must be specified to match the characteristics of the kind of data reported and the reporting schedules. Little is gained from standardization if too many different formats are specified. The difficulty in this task thus lies in striking a balance between the number of forms and the appropriateness of a generalized reporting format to particular data reporting situations.

It is estimated that 3 man-months of effort will be required to complete this task.

2) DB-2 - Procedures for Conversion

In addition to selecting reporting formats and media, it is necessary to select reporting schedules and, for each specific kind of environmental parameter measurement, to determine when, where, and how the raw data are to be converted to summarized representation. This determination must consider the format and media of the raw data, any delays associated with generating or reducing the raw data (as in the time required to perform a laboratory analysis), and the location at which the raw data become available (the laboratory analysis might be reported to the location at which the sample was taken, to the EFD, directly to the NEPDB center, or to any combination of the three locations). It is also necessary to factor in the results of Task DB-3,

in which the procedures for validation of the data are specified. Validation procedures may most conveniently take place when the data are reduced and converted to summarized form, provided that the data necessary to establish confidence levels and measurement tolerances are available. Clearly, the procedures and resource requirements for conversion and validation of oil spill reports are vastly different from those for conversion and validation of a continuous strip-recorder output.

The SRI design concept calls for most of this conversion to be performed manually. The procedures established in this task will reflect this fact and attempt to implement the most efficient use of personnel resources. The Parameter Measurement Summary Record shown in Figure 6 is an example of how a reporting format can yield efficient manual conversion procedures and convey maximum data set information.

It is estimated that this task will require 2 man-months of effort.

3) <u>DB-3 - Confidence and Tolerance Levels Procedures</u>

The third task requires specification of procedures for validating reported data and, associated with this process, estimates of its quality, the tolerances of the parameter measurement, and the levels of confidence with which the reported values can be used. As in the case of Tasks DB-1 and DB-2, it is necessary to address the kind of data and the method of measurement. A number of procedures will thus be

established. Again, a principal justification for including the individual Naval locations within the scope of the NEPDB system is to allow uniform procedures for validating data and establishing confidence and tolerance levels to be imposed.

Several of the more promising procedures for validating data and establishing confidence levels and tolerances have been identified and discussed in the preceding sections. One method for reporting this information is shown as a part of Figure 6, referenced above. It is estimated that this task will require 1 man-month of effort for completion.

Clearly, Tasks DB-1, DB-2, and DB-3 are highly interrelated and must be performed together in an interactive fashion. To specify data and report formats it is necessary to have knowledge of both conversion procedures and procedures for establishing data confidence and tolerance levels. Thus, although the tasks have been described separately, they must be performed simultaneously, in parallel. It is estimated that an additional 3 man-months will be required to document the procedures and produce user handbooks.

d. System Test

Three tasks must be performed during the development of the NEPDB system to ensure that the design is satisfactorily implemented. These three tasks correspond to the three main functions performed during the operation of the data base system and are as follows:

Task ST-1 - Request-handling test

Task ST-2 - Data-handling test

Task ST-3 - Deficiency assessment test.

Because the second phase of the NEPDB design specifies a requirement for the NEPDB to answer five user questions, at least part of the testing will have to be done during the detailed design period. Thus, since the detailed design will have provided definitive procedures for the execution of these three functions, the testing tasks will use sample scenarios to evaluate the system logic's ability to process and operate as required.

To test the request-handling function, additional questions will be used to test the system logic. A representative question from each question type will be used as a minimum test for that question category. In some cases several questions from a category, each using a different set of logic paths, will be necessary to test the system handling of a given question type. Candidate test questions will be drawn from the NCEL-provided list of typical user questions, plus others generated by SRI during the design phase.

Data handling and deficiency assessment testing will be less complicated than request-handling testing because of the relatively predetermined character of the data received and the assessment process. A reasonable range of data categories will be used to test the

data-handling processes. Deficiency assessment will be tested for each environmental parameter category and for each Navy activity type.

It is estimated that 2 man-months will be required for these three tasks during the implementation phase.

e. Implementation Support

Three specific tasks are designated for implementation support:

Task IS-1 - Training

Task IS-2 - System documentation

Task IS-3 - User guides.

These tasks support the other implementation efforts and are related to each other. Training is a necessary function to ensure that the designed NEPDB procedures are properly and efficiently executed. Since the personnel training is necessary for each function, it is more convenient to estimate the overall manpower requirements for training than each individual item. An overall time estimate for system training is 5 man-months.

System documentation is intended to describe the procedures that cover overall system operation, procedures, data files, and data sources. Documentation of each individual function and operation is generated separately from this task. This task is estimated to require 1 man-month of effort.

The development of user guides for use by system operating personnel is considered necessary to provide a clear set of rules whereby each staff member has an understanding of the purpose of his function and a precise guide to performing it. It is vital that each staff member knows how his function relates to other functions and which data he must obtain from and provide to other parts of the system. The care taken in preparing these guides and ensuring their lucidity and completeness will significantly affect the system effectiveness and system user satisfaction. It is estimated that 3 man-months is required to complete this task.

It should be noted that estimates for training Navy base personnel who would act as part-time members of the NEPDB system is not included here. It is believed that a 1-week workshop for these personnel would be advantageous to enhance their contribution to the NEPDB system.

f. Summary

Implementation manpower estimates are totaled below:

Task	Man-Months
DO-1 DO-2 DO-3	0 (Final design effort)
DO-4	45.5 to 96
DO-5	6 (100 computer hours required in addition)
Total	51.5 to 102
SF-1	0
SF-2	2.5
SF-3	1.0
Total	3.5

Task		Man-Months
DB-1	3	(plus 3 for documentation/handbooks)
DB-2	2	
DB-3	1	
Total	9	
ST-1		
ST-2	2	
ST-3		
Total	2	
IS-1	5	
IS-2	1	
IS-3	3	
Total	9	
Grand Total		85 to 125.5

3. Operational Cost Estimates

Estimates on the expected data quantity to be processed were made during the Concept Definition study and were frequently changed during the last portion of that study as more information and understanding of the Navy's monitoring activities were obtained. These estimates are shown in Section VIII-C.

a. Navy Installations and Associated Activities--System Operations

Table 26 shows a list of the Navy installations and associated activities used for these estimates. Since that section was written, the estimates have been modified. It was felt that some of the environmental parameter estimates and estimates of agencies producing standards should be revised and that a different method of arriving at data quantities should be [illegible]sed. This is shown below.

Table 26

NAVY INSTALLATIONS AND ASSOCIATED ACTIVITIES

NARF	Air Station	Ammunition	Station
Alameda	Patuxent R.	Bremerton	Annapolis
Cherry Point	Point Mugu	Crane	Boston
Jacksonville	Atlanta	Earle	Brooklyn
Norfolk	Brooklyn	Hawthorne	Charleston
North Island	Chase Field	Hingam	Key West
Pensacola	Corpus Christi	McAlester	Mayport
Quonset Point	Dallas	Oahu	Newport
	Ellyson Field		Norfolk
	Glenview		Philadelphia
	Glynco		Adak
Supply	Grosse Ile	**Shipyards**	Dutch Harbor
	Kingsville		Kodiak
Bayonne	Los Alamitos	Boston	Long Beach
Charleston	Memphis	Charleston	Pearl Harbor
Long Beach	Meridian	Hunters Point	San Diego
Newport	New Orleans	Long Beach	San Francisco
Norfolk	Olathe	Mare Island	Sangley Point
Oakland	Pensacola	Norfolk	
Pearl Harbor	Sautley Field	Pearl Harbor	
Puget Sound	Seattle	Philadelphia	
San Diego	South Weymouth	Portsmouth	
	Twin Cities	Puget Sound	
	Whiting Field	Brooklyn	
Air Technical	Willow Grove		
Training	Albany		
	Brunswick		
Pensacola	Cecil Field		
Jacksonville	Jacksonville		
Lakehurst	Key West		
	Lakehurst		
	Norfolk		
	Oceana		
	Quonset Point		
	Richmond Heights		
	Alameda		
	Fallon		
	Imperial		
	Lemoore		
	Miramar		
	Moffett Field		
	North Island		
	Whidbey Island		

Each activity will monitor its own discharges periodically. Monthly summaries will be sent to the centralized data bank. Therefore, the minimum sampling period should be 1 month.

Each activity could submit one summary form for each of the following:

(1) Water (20 parameters per facility)

(2) Air (10 parameters per facility)

(3) Noise (2 parameters per facility)

(4) Oily waste (5 parameters per facility)

(5) Solid waste (3 parameters per facility)

Each activity could have as many as 5 governing regulations:

(1) Federal

(2) State

(3) Regional

(4) County

(5) Local

for each of the categories for a total of 25 regulations.

SRI anticipates that 1 data analyst can process 400 parameters per day and 1 keypuncher can punch and verify 25 summaries per day. Because data summaries are dependent on numbers of Navy installations reporting and because this latter number is likely to grow as the NEPDB system is operational, an estimate of 100 to 250 data summaries per month arriving at the NEPDB center was used as a basis for subsequent manpower requirement assessments. It is estimated that 1 data analyst and 1 keypunch operator could process 250 summaries per month.

b. Personnel Requirements--System Operation

Summarized data will be required of all activities performing periodic monitoring. The summary should require no more than 2 man-days per month for each activity. If special personnel are required to perform monitoring, then these same people could do the data summaries as part of their monitoring duties.

During the first year of operation, beginning in Fiscal 1974, the operational staff of the NEPDB system is expected to be organized approximately as shown in Figure 36.

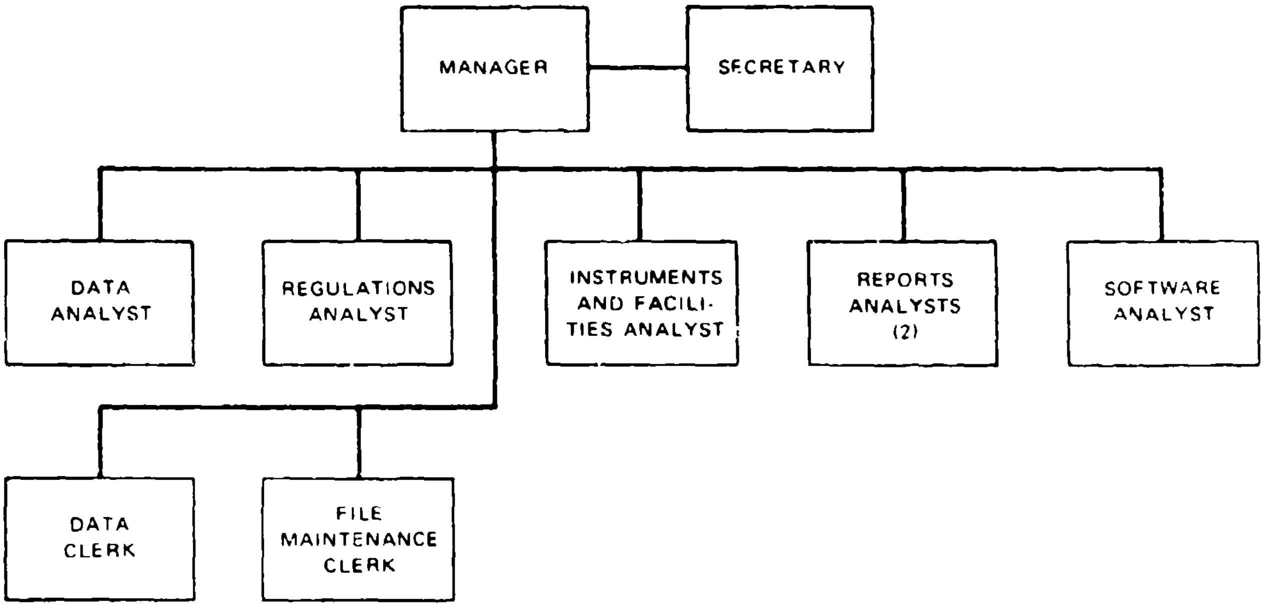


FIGURE 36 FIRST-YEAR NEPDB SYSTEM OPERATIONAL STAFF

The system manager will supervise total system operation. His activities will include personnel supervision and management, reviewing all requests against the data base for purposes of granting or obtaining necessary authorizations and dispatching requests to appropriate

personnel for action, making decisions regarding incorporation into the data base of new data categories, and identifying requirements for change or enhancement of the system and initiation of appropriate action.

The system secretary will act as a receptionist for requests against the data base and arriving data, maintaining associated system logs, and acting as a central point through which various transactions are coordinated and controlled. This will be in addition to whatever stenographic and clerical duties are necessary to support the system manager and staff.

The data analyst will be responsible for processing all environmental parameter measurement data entering the system and will be the point to which queries about that data are directed. The regulations analyst will perform the same function but will specialize in environmental control standards and regulations. The instruments and facilities analysts will perform the same functions but will specialize in monitoring and instrumentation equipment and techniques, control and abatement equipment and techniques, and information about Naval facilities. Queries and data about other subjects will be directed to one of the three analysts according to his experience, ability, and availability.

One of these three analysts will supply the library science skills required by the system. (By library science skills is meant that training and experience necessary to establish procedures

and determine policy from a library data base viewpoint, not the detailed indexing or physical file maintenance often associated with a librarian. Following the system implementation period, it is estimated that no more than 1 man-day per week of such a capability will be required to maintain system operation.)

Two personnel are assigned to the generation of more lengthy reports. The system baseline demand was originally specified as 40 requests and two reports per week. It is assumed that most of the 40 requests will be rather brief and can be satisfied either by one of the three specialists described above or by access to other system resources in the various EFDs. The two personnel identified here will have the task of satisfying more general requests requiring generation of reports. Of course, some part of the information included in such reports will be obtained through collaboration with the specialists or other resources. These two personnel are thus generalists.

The software analyst will be responsible for implementing enhancements to the system and for accomodating data processing necessary for satisfying certain requests against the system. Two enhancements desirable during the first year of system operation are implementation of an on-line data base indexing capability and a data summarization, aggregation, and assembly capability, as described earlier in this report.

The data clerk is responsible for data capture, verification, and proofreading functions. In fact, 2 or more personnel, part-time each, may be employed to fulfill this requirement. The net should total approximately 1 man-month per month.

The file maintenance clerk is responsible for the physical maintenance of the data base files. To the extent that this task does not require a full-time effort, this person can support the data clerk.

It should be noted that most of the operational staff can and should play an important part in the system implementation. This would avoid peaking of personnel requirements and provide the best possible means of training personnel who will have operational responsibility. Availability of the five analysts and the software specialists two to three months before the scheduled start of implementation is desirable. (Note that certain data collection tasks begin during the final three months of the design phase in the schedule assumed by SRI.)

After the first full year of NEPDB system operation, it is likely that some shift in personnel skills will occur because of the completion of some data collection and organization tasks and system operational experience. One possible consequence of such factors is shown in Figure 37. The volume of environmental parameter measurement

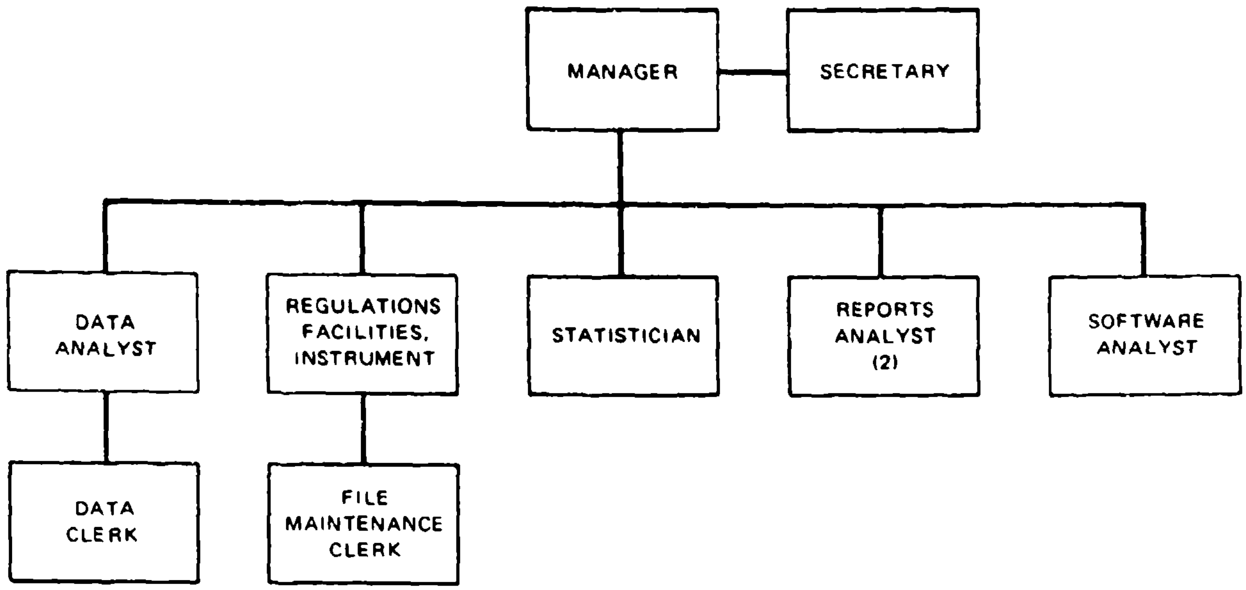


FIGURE 37 SECOND-YEAR NEPDB SYSTEM OPERATIONAL STAFF

data is not likely to decrease and that function remains. However, the initial load of collecting regulation, facility, and instrument data should settle to a steady state. One specialist should be adequate to handle these data and requests to these data. A new specialty appears in the figure--the statistician. This person supports requests requiring statistical analysis and/or modeling but is not required to process in-coming data. The two generalists for extended report generation and the software analyst are as before. An additional software analyst may be required if the demand for computer processing to support requests increases or if the rate at which system enhancements are justified is sufficiently great.

Implementation of the NEPDB system should follow a plan designed to be flexible in meeting the demands of the user. The basic configuration should exhibit an independence from the computer hardware, should minimize staff increases, and should fit within the present established Navy framework. However, the system must react to changing demands and/or constraints if it is to be a viable system.

4. Assumptions That Require Validation

The SRI study team had to make several assumptions in the formulation of a conceptual Design. Those that require validation are listed below in a priority sequence.

a. First Priority Validation

The assumptions that should be validated first are as follows:

- SRI assumed that sufficient data would be collected to ensure that the Navy could determine its compliance with standards.
- There is a need to determine quantitatively and qualitatively the expected data generation resulting from the Navy's monitoring program.
- There is a need to categorize facilities according to their waste potential.
- A plan should be developed to integrate smoothly individual facility monitoring and Navy-wide data collection requirements.
- SRI assumed that sufficient data would be collected to assign confidence levels to data entering the data base.
- SRI recognized the need for a comprehensive survey of all standards affecting Navy facilities. Insufficient

time precluded SRI from doing more than making a value judgment.

- On the basis of previous experience, SRI assumed a summary reporting period of one month. Some consideration should be given to justify this assumption in terms of Navy monitoring plans.
- SRI assumed that the Navy would provide the monitoring personnel since the NEPDB system would place only a small additional duty on these monitoring personnel. If this assumption is wrong, the system configuration and the NEPDB personnel requirements will be changed drastically. Therefore, more study is required in this area.
- In the system design and trade-off analysis it was assumed that the individual facilities would generate sensitive data that would remain at the local level. This assumption should be checked and the type and quantity of sensitive data should be enumerated.
- SRI assumed that microfilm working storage techniques will not readily be acceptable to NEPDB personnel.

b. Validation Required Before Implementation

After the assumptions listed above have been validated, the assumptions listed below should be validated before the NEPDB system is implemented.

- SRI assumed that RECON teams or the present test teams would be reassigned to check periodically the monitoring procedures and instruments at all facilities reporting to the NEPDB.
- SRI assumed that a priority index of valid users would be established by NEPDB. The list of potential users developed by SRI would need to be refined and integrated into this priority index.

5. Studies To Be Made

Several supporting studies are necessary to ensure that the NEPDB system fulfills all the environmental responsibilities required

by Presidential Executive Orders and DoD and Naval Directives. These are discussed below.

a. First Priority Studies

Studies that should be made first are:

- The role of the EFDs in the NEPDB. This role was examined with regard to WESTDIV only. Because the EFDs are a vital part of Navy environmental plans, the role of all the EFDs should be carefully defined. This study should be done immediately since the entire system configuration could change if the assumptions about the role of the EFDs are wrong.
- A study should be conducted to determine if the recommended system configuration is acceptable to personnel envisioned as part of the system.
- SRI recommends that representative potential users of the NEPDB system be questioned about their needs and expectations. It recognizes the problems associated with interviewing people about a system that is not yet implemented but feels some necessary information about sizing can be obtained.
- SRI examined in detail the type of data that would be required in the data base. It is expected that the data categories list is complete. However, an extensive survey must be undertaken to determine what data are currently available and the extent of their usability. SRI has anticipated the problem and has identified several possible data sources.
- Since all activities visited by SRI personnel were in one geographical location, the problems associated with them are probably unique. Therefore, visits should be made to other activities, including at least one of the three test sites.

b. Studies Required Before Implementation

The following studies should be made before the NEPDB system is implemented:

- Personnel cognizant of Navy environmental problems should be contacted and catalogued according to their areas of knowledge.
- All personnel currently connected with the NEPDB should be polled to gain information on problem areas and deficiencies in current methods, hardware, and personnel.
- SRI recommends that a study be undertaken to identify emissions that are expected to be the most troublesome in terms of measurability and environmental impact.

6. Completed or Continuing Studies

The following studies have been completed or are on-going:

(1) An analysis of Navy directives related to environment protection is partially complete to April 1972. Further analysis should be carried out through the first part of the detailed design phases.

(2) One EFD environmental group, one shipyard, one air station, and one NARF were visited to obtain on-site information.

(3) SRI completed an in-depth study of candidate functions. Extension of this study and detailed functional diagrams will be completed in the preliminary and final design phases.

- The trade-off analysis was directed primarily towards:
  - Centralized versus decentralized functions.
  - Manual versus automatic functions.
  - Various index and storage/retrieval media.

  SRI believes the trade-off analysis is complete within the framework of a conceptual design. During Phase II and Phase III the analysis will be refined as new information becomes available and more constraints are imposed.

- SRI studied the possibility of initially implementing a highly automatic system. However, it was concluded that supporting data were insufficient to produce an effective design and that a design based on poor data could seriously jeopardize the entire project. It was also concluded that various functions should be automated but

that automation should occur only after implementation of the basic system.

7. Growth Considerations

In Section I of the final report, SRI presents a feasible, viable, semimanual system that should be implemented initially. This in no way implies that the final system configuration will be predominantly manual because the final configuration will be structured by usage, constraints, and hardware viability. At this point the need for on-line, computer-generated indices and some computerized data-handling routines is recognized. But considerable testing and study are required before a viable scheme can be devised for this particular application. It would be short sighted to prescribe an expensive computer-assisted design on the basis of current knowledge about data and usage. A better path is to design a system that is less sensitive to data and usage demands. Then, using information gleaned from operating the less-sophisticated system makes enhancements to expand capabilities and increase efficiency. In Section XIV C five options are presented that should be considered for growth as soon as the initial system is operational.

For example, there are a number of ways in which the computer can be used to augment or enhance system performance. The most attractive requires the transcription of raw data to a computer-readable medium and use of the computer to summarize and perform certain of the validation procedures. The extent to which this is feasible or desirable in an initial implementation to be completed by the end of Fiscal 1973 is to

be determined as a part of the Phase II preliminary detailed design effort. Current expectations are that little use will be made of the computer for this purpose in the initial implementation. However, this remains one of the most attractive candidates for system enhancement immediately following completion of the initial implementation. Tasks DB-1, DB-2, and DB-3 must be performed with this consideration in mind to minimize procedural changes in any transition from a manual to a computer-aided data reduction system.

One of the direct advantages of the use of the computer as an aid to data summary is that it lays the foundation for the use of the computer for aggregation and assembly of data. This significantly reduces the sensitivity of the system to demands requiring the assembly, collation, or aggregation of large numbers of data elements. In an all-manual system the time required to assemble a group of data elements is directly proportional to the number of data elements to be assembled. If the computer is available to aid in such assembly, the manual time requirement is that for formulation of the assembly request. To implement the computer generation of indices to the data base, much of the data base content is put in computer-readable form and made into computer accessible files. If, in addition, the manual system is enhanced by addition of computer aids for data summary, reduction, and validation, most of the remaining data base content is available to the computer. It remains to implement a means for using the computer to assemble, collate, or

aggregate data from this data base. This still falls somewhat short of what would be considered a fully automated system. The implementation costs are modest and the implementation of a fully operable NEPDB system capability does not depend on the completion of any of these enhancements. This discussion is intended to demonstrate that the manual system that has been advanced as SRI's design concept by no means prohibits growth into computer-aided capabilities; on the contrary, there is a natural direction for system growth through the use of computer aids. Because the initial system implementation provides full operational NEPDB capabilities, decisions regarding which of these aids are to be implemented and according to what schedule can be made after some experience with actual system use has been obtained. This would also permit avoidance of peak resource requirements during the initial implementation period. Virtually all the design and implementation effort put into the manual system is directly applicable to the enhanced systems.

Throughout the conceptual design phase reference is made to an initial implementation date of July 1973. If this date were to be slipped, SRI believes that some form of an initial operational capability should be established as near the July 1973 date as possible to provide the framework for the development of an NEPDB system that can meet the growth of environmental technology and the demands of changing environmental standards. Some of the enhancements referred to in SRI's design

rely on information about the suitability and performance of the various functions of the initial system before they can be implemented satisfactorily. Therefore, SRI believes the initial implementation should be a simple manual system with modest computer assistance, paralleled closely by a study and trial implementation phase. As results of usage, study, and testing are compiled, appropriate enhancements can be undertaken.

Appendix A

BACKGROUND DETAILS OF ANALYSIS OF NAVY DIRECTIVES

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BACKGROUND DETAILS OF ANALYSIS OF NAVY DIRECTIVES

I INTRODUCTION

An analysis of Navy-related directives was undertaken to establish user responsibilities and requirements with regard to environmental quality and environmental monitoring. In addition, user questions leading to the satisfaction of user requirements were formulated to supplement the list of questions supplied by NCEL. Finally, a commonality matrix of user responsibilities, user requirements, and user questions was prepared from the information assembled in the analysis.

II ANALYSIS OF DIRECTIVES APPLYING TO THE NAVY

A. Executive Order 11514 (March 5, 1970)

1. Policy

"The federal government shall provide leadership in protecting and enhancing the quality of the nation's environment to sustain and enrich human life. Federal agencies shall initiate measures needed to direct their policies, plans and programs so as to meet national environmental goals."

2. Responsibilities

The heads of federal agencies shall:

- Monitor, evaluate and control; develop programs and measures; assess progress in meeting the specific objectives; consult with other agencies.
- Develop procedures to ensure dissemination of federal activities to obtain the views of interested parties.
- Ensure that information regarding existing or potential environmental problems and control measures are made available to federal, state, and local agencies.
- Review their policies to find deficiencies that prohibit or limit full compliance of their responsibilities.
- Engage in data and research exchange.

The Council on Environmental Quality shall:

- Evaluate existing and proposed policies and make recommendations to improve effectiveness.
- Recommend priorities.
- Determine the need for new policies.
- Conduct environmental hearings.

- Promote monitoring systems.
- Coordinate federal environmental programs.
- Advise and assist in international programs.
- Issue guidelines for the preparation of environmental legislation.
- Foster investigations, studies, surveys, research and analyses of environmental relevance.

B. Executive Order 11507 (February 4, 1970)

1. Policy

"The federal government in the design, operation, and maintenance of its facilities shall provide leadership in the nationwide effort to protect and enhance the quality of our air and water resources."

2. Responsibilities

Heads of agencies shall:

- Maintain review and surveillance to ensure that designated standards are met.
- Identify potential environmental problems associated with the use and production of new materials.
- Consult with secretary concerning environmental protection and enhancement procedures.
- Develop and publish procedures.

The respective Secretary shall provide leadership and technical assistance.

Council on Environmental Quality shall monitor the implementation of this order, making periodic presidential reports.

Note: It is the responsibility of the heads of agencies to ensure that their facilities meet the specified requirements.

3. Requirements

Facilities must:

- Conform to designated standards.
- Minimize waste through recycling.
- Use existing municipal or regional waste disposal systems whenever possible; if not possible, then:
  - Operate their own system
  - Provide adequately trained personnel
  - Establish operator performance levels compatible with local guidelines.
- Minimize air and water pollution when handling all materials (liquid, solid, and gaseous).
- Not dispose of waste or discharge waste in a manner that pollutes ground water supplies.
- Discharge radioactive material in a manner that conforms to AEC regulations.
- Initiate procedures for abatement of air and water pollution.

Note: The respective Secretary has the responsibility of determining that performance specifications for each facility (supplied by the agency head) are adequate to meet requirements. This procedure applies to all new and/or old facilities.

C. SECNAV Instruction 6240.6B (November 2, 1970)

1. Policy

Pollution of the environment by the installations, facilities, equipment, vehicles, and other property owned and/or operated by DoD shall be controlled. To this end:

- All DoD components will demonstrate leadership in pollution abatement.

- Where resources to accomplish pollution control are limited, priority of effort will be afforded in accordance with the following order:
  - Man's health
  - Economic implications
  - Recreational and aesthetics.
- Maximum effort will be made to incorporate environmental pollution preventive measures in basic designs.
- DoD will cooperate with other agencies.
- Surveillance resources will be utilized to the extent that circumstances permit.
- Pollution abatement at overseas installations will conform to the foregoing policies.

2. Responsibilities

The Assistant Secretary of Defense (Health and Environment) shall:

- Ensure effective cooperation with other elements of the Office of the Secretary of Defense.
- Identify and evaluate activities and conditions affecting environmental quality.
- Ensure that environmental quality problems associated with new materials are recognized and controlled.
- Implement pertinent Executive Branch guidance concerning environmental quality programs.
- Advise on environmental consequences of major DoD activities.
- Have management control of the DoD Environmental Pollution Control Committee.

The Assistant Secretary of Defense (Installations and Logistics), or his designee shall be responsible for:

- Real property facilities pollution control.
- Establishing environmental values in military construction.

- Conserving land and natural resources.
- Publication of pollution control procedures.

The Director of Defense, Research and Engineering, or his designee shall be responsible for:

- Environmental pollution research and research coordination.
- Prompt dissemination of research results.

The Secretaries of the military departments and the DoD Agencies shall:

- Identify and correct pollution problems.
- Make provisions in their programming budget estimates and financing programs for providing a quality environment. The cost of environmental quality programs must be accomplished within financing available to the military department or Defense Agency.
- Monitor environmental quality control methods to ensure that these methods maintain the required general standards of quality.

3. <u>Requirements</u>

DoD components must:

- Be consistent with applicable standards.
- Use municipal or regional facilities.
- Minimize pollution in handling material.
- Not pollute ground water.
- Discharge radioactivity according to AEC provisions.
- Where no standards are available, refer the matter to the Assistant Secretary of Defense, Health and Environment.

Note: Establishment of the DoD Environmental Pollution Committee.

D. OPNAV Instruction 6240.1A (April 4, 1969)

1. Policy

Projects included in budget requests for new facilities and buildings in the U.S. must provide for the installation of water pollution control equipment where necessary. To this end:

- Air/water pollution abatement projects will, in general, be included in the military construction programs.
- Air/water pollution control systems will be designed to comply with applicable standards.
- Old construction contracts must comply with new standards and guidelines.
- DoD components will cooperate with the EPA and with the Division of Air Pollution, Health, Education and Welfare by furnishing pertinent data at all installations.

2. Requirements

DoD components shall:

- Give specific attention to defined environmental problem areas.
- Include a certification statement on form 1391/1391c for each Military Construction line-item proposed for programming action.
- Submit to the Assistant Secretary of Defense (Installations and Logistics) a phased and orderly plan for the prevention, control, or abatement of pollution from existing facilities.

E. OPNAV Instruction 6240.6A (March 24, 1967)

1. Policy

Pollution of the environment by the operation of Naval ships, installations, facilities, or buildings shall be controlled.

2. <u>Responsibilities</u>

The responsibilities assigned to the Systems Commands, the Bureau of Naval Personnel and the Bureau of Medicine and Surgery will be performed under the overall guidance of the Chief of Naval Material and/or the Chief of Naval Operations.

The Commander, Naval Facilities Engineering Command, will be responsible for:

- Implementation of the Environmental Pollution Control Program.
- Sponsor-related Military Construction and Operations and Maintenance projects for Naval shore activities.

The Commander, Naval Ship Systems Command, will implement the Environmental Pollution Control Program as it concerns Naval ships.

The Chief, BUMED, will establish health standards and criteria and coordinate the Environmental Pollution Control Program as it affects the health and welfare of Naval personnel.

The Commandant of the Marine Corps will implement the Environmental Pollution Control Program with respect to Marine activities.

All systems commands, BUMED, and BUPERS will provide continuing effort to eliminate pollution.

NAVFACENGCOMHQ, NAVSHIPSSYSCOMHQ, BUMED, and Headquarters, Marine Corps will appoint a representative to serve on the DoD Environmental Pollution Control Committee.

3. Requirements

NAVFACENGCOM (through EFDs) shall:

- Identify environmental polution problems, establish requirements for corrective actions, and provide technical assistance for all Naval shore activities and government-owned, contractor-operated plants.
- Sponsor environmental pollution abatement programs.

NAVFACENGCOM shall submit the overall Navy environmental plan.

Naval shore activities (including Marine Corps) shall submit plans to the EFDs for technical review.

NAVSHIPSYSCOM shall examine ship waste disposal practices and take the necessary abatement steps where necessary.

All Systems Commands and Bureaus shall review and correct their operations with respect to environmental quality.

F. OPNAV Instruction 6240.2A (December 11, 1970)

1. Policy

Assessment of environmental impacts is the foremost step in any major action of new, old, or continuing programs.

2. Responsibilities

The Deputy Chief of Naval Operations (Logistics) shall:

- Develop and promulgate impact statement guidelines.
- Coordinate with President's Council of Environmental Quality.
- Act as a focal point for commands concerned with the preparation of statements.

All Ships and Stations shall maintain a continued surveillance of planned or current actions and prepare impact statements where required.

3. Requirements

All Ships and Stations shall prepare environmental impact statements.

G. OPNAV Instruction 6240.3A (September 14, 1971)

1. Policy

Pollution of the environment by the operation of Naval ships, installations, facilities, or buildings shall be controlled.

2. Responsibilities

The Deputy Chief of Naval Operations, Logistics, shall:

- Direct, coordinate, and monitor the results of the environmental program.
- Provide Navy focal point for review of environmental impact statements.
- Maintain control of all target ship sinkings and deep water dumping operations.

The Deputy Chiefs and Directors of major staff offices shall take continuing actions for the furtherance of environmental quality in their areas.

The Chief of Information, CHINFO, shall coordinate and supervise environmental information dissemination.

The Chief of Naval Material shall:

- Identify and evaluate on a continuing basis activities and conditions affecting environmental quality, including but not limited to air and water pollution, solid waste management and disposal practices, noise, sources of thermal energy, ionizing and non-ionizing radiation, chemical agents, and biological research materials.

- Validate all projects and programs to correct Navy-wide deficiencies.
- Perform environmental research.
- Develop and implement all environmental protection programs.
- Participate in the development of pollution monitoring systems
- Investigate problems associated with new materials.
- Advise on the environmental impact of major Navy activities.
- Maintain focal points of contact for the coordination of Navy requirements and transactions between the field divisions and non-Navy agencies.

The Chief, Bureau of Medicine and Surgery, shall:

- Determine, validate, and establish health standards and criteria; conduct research and monitor health hazards (toxicology and environmental medicine).
- Designate a member to represent BUMED on the DoD Environmental Pollution Control Committee.

The Chief of Naval Training shall direct the establishment of training programs.

Area Coordinators shall coordinate environmental protection and enhancement programs and coordinate public disclosure of Navy environmental programs.

The Oceanographer of the Navy shall determine environmental effect of Navy operations and pollutants in the ocean.

The Commander, Naval Weather Service, shall establish procedures for issuing meteorological forecasts and warnings pertinent to pollution control.

All Other Navy Offices and Commands shall identify environmental quality problems and take corrective measures.

Major Claimants, Area Coordinators, and Naval Base Commanders shall:

- Identify and maintain current information on all aspects of their operations significantly affecting environmental quality.
- Determine the feasibility of taking action to improve quality.
- Develop implementation instructions for any program.

3. Requirements

All above personnel are directed to initiate aggressive action to combat environmental pollution.

Area Coordinators will develop regional environmental protection plans, identifying pollution problems and corrective action required.

H. OPNAV Notice 5430 (October 13, 1970)

1. Policy

Establishment of the Environmental Protection Division (OP-45) within the Office of the Chief of Naval Operations (EPOO) is being formed to expand and centralize Navy efforts to curb pollution and address environmental problems, and to exercise overall coordination of relevant programs within the Navy Department through the DCNO (Logistics).

2. Responsibility

The director of EPOO is responsible for the successful accomplishment of the mission stated above.

I. OPNAV Notice 6240 (April 28, 1970)

1. Requirements

All hands must take necessary measures to ensure that wastewater treatment plant reports and information relating to discharged effluents are supplied to requesting state agencies.

2. Responsibilities

The furtherance of environmental quality is an all-hands responsibility encompassing all facets of Naval activities. Cognizant OPNAV offices assigned areas of responsiblity for direction and review of environmental quality programs are as follows:

(1) OP-33 - Fleet operational procedures and employment of fleet resources for pollution control.

(2) OP-04H - Industrial health, hospitals, and use of herbicides and pesticides.

(3) OP-403 - Naval Fuel Depots.

(4) OP-43 - Shipboard systems and equipment.

(5) OP-44 - MILCON program for air and water pollution abatement and Naval stations/bases.

(6) OP-70 - Research Development, Test and Evaluation, Test Ranges, and Evaluation Facilities.

(7) OP-75 - Radioactive materials.

(8) OP-007 - Public affairs associated with the Navy's efforts in environmental quality.

J. NAVMAT Notice 6240 (November 12, 1970)

1. Responsibilities

The Deputy Chief of Naval Material, Logistics shall be responsible for the overall management aspects of Navy Environmental Protection Program. MAT 044 is the Environmental Protection Coordinator.

The Research and Development Coordinator (MAT 0342) shall be responsible for:

- Formulating a complete R&D program.
- Ensuring the inclusion of environmental protection criteria in any applicable Navy system.
- Recommending and reviewing Environmental Statements on NAVMAT R&D projects.

K. MEMORANDUM (Sub-CAB, January 22, 1971)

The following items shall be noted:

(1) A Pollution Control (PC) Organization in Headquarters would act as a focal point for COs and EFDs (= PC-4).

(2) The EFD Commander/CO often needs information on the environmental aspects of various projects and activities, and the EFD customer must be able to obtain environmental advice and services. Therefore, the Code 90 office would act as the environmental focal point and will be established as Code 90E.

L. NAVFAC Instruction 6240.1 (August 29, 1966)

1. Objective

". . . to improve the quality of the Nation's air and water resources through the prevention control and abatement of air and water pollution from Naval activities."

2. Policy

"All efforts as required will be taken to prevent pollution emissions from Military installations, so that the health and welfare of people, the economic, recreation and aesthetic value of our natural resources and the aquatic environment for fish, shell fish and wild life, will not be adversely affected."

To this end the Navy will demonstrate leadership in pollution control and will make maximum effort to incorporate pollution control measures in new construction.

3. Requirements

NAVFAC EFDs shall:

- Maintain surveillance to ensure that all discharges comply with applicable standards.
- Cooperate fully with government agencies.
- Identify existing sources that do not meet standards and initiate corrective programs.
- Submit a description of the essential features of corrective measures for all Environmental Pollution Control projects to the appropriate federal agencies (EPA, USPHS, and others).
- Assign the responsibility of the Environmental Pollution Control Program to the Sanitary Engineer in the Utilities Division.

  The Sanitary Engineer, in turn, shall

  - Conduct surveys
  - Provide initial plans for improvement
  - Review all construction plans
  - Report to federal agencies.

M. NAVFAC Instruction 6250.12 (April 1, 1970)

1. Policy

The outdoor application of persistent pesticides shall be limited where possible.

2. Requirements

Requests for outdoor operations involving pesticides will be forwarded to the NAVFAC EFD Applied Biologist for coordination with the local representatives of federal agencies.

N. NAVMAT Instruction 5100.3 (July 17, 1969): ESTABLISHMENT OF THE NAVY HAZARDOUS MATERIAL SAFETY PROGRAM (NHMSP)

1. Policy

The quantity of hazardous material procured and used by an activity or ship must be minimized. Standards and criteria for use of hazardous material shall conform to and be harmonious with existing federal or other nationally recognized standards.

2. Responsibilities

The Chief of Naval Material shall:

- Develop and administer NHMSP and provide the Navy focal point for all policy matters relating to hazardous material safety.
- Arrange for the collection, analysis, and dissemination of data on hazardous material.

Systems Commanders and Project Managers shall

- Provide the Commander NAVSUPSYSCOM with information on hazardous materials.

- Prepare and publish safety precautions for use of hazardous material and guidelines for use.
- Recommend to CNM modifications to NHMSP.

The Commander, Navy Supply Systems Command, shall:

- Promulgate appropriate implementation procedures for control of hazardous material.
- Develop and publish a Consolidated Hazardous Item List (CHIL) that provides the Navy with a cross-referenced listing of hazardous materials and provide data on all aspects of hazardous materials.

All Commands and Activities shall:

- Implement the directions of the NHMSP.
- Ascertain the hazardous nature of materials.

III SUMMARY OF USER REQUIREMENTS

Following the directives analysis, a commonality of requirements for each Navy office was formed.

A. Secretary of the Navy

It is the duty of the Secretary of the Navy to:

(1) Ascertain that standards are met.

(2) Identify potential air and water quality problems associated with new materials.

(3) Establish requirements for operators of pollution control facilities to meet levels of proficiency required by that state.

(4) Monitor activities to ascertain that there is no detrimental effect on the environment.

(5) Determine how well pollution of the environment is being controlled at Naval activities.

(6) Determine what sources of pollution at Navy installations constitute a direct health hazard to man, to plants, and to other animals.

(7) Determine what sources of pollution affect primarily the recreational and esthetic value of our natural resources.

(8) Determine what are the federal, state, and local regulations, standards, and criteria relating to pollution abatement that affect a Navy installation.

(9) Ascertain if a Navy installation conforms to the federal, state, and local pollution abatement regulations.

(10) Monitor environmental quality control methods to ensure that they maintain required standards.

B. <u>DoD Components</u>

It is the duty of DoD components to:

(1) Provide pertinent pollution monitoring data showing performance of facilities with and without abatement.

(2) Provide surveillance of facilities to ensure that air and water quality standards are met.

(3) Provide data necessary for permits to discharge or deposit into the navigable waters of the U.S. or their tributaries.

(4) Provide pollution information needed for a cost-effectiveness study.

(5) Define applicable standards for the pollutants under consideration.

C. <u>Assistant Secretary of Defense, Health and Environment</u>

It is the duty of the Assistant Secretary of Defense, Health and Environment to identify and evaluate activities and conditions affecting environmental quality.

D. <u>Assistant Secretary of Defense, Installations and Logistics</u>

It is the duty of the Assistant Secretary of Defense, Installations and Logistics, to identify pollution from real property facilities.

E. <u>Naval Facilities Engineering Command (NAVFAC)</u>

It is the duty of NAVFAC to determine:

(1) What measures are available and what has been their previous effectiveness in protecting grounds, structures, and materials from pests.

(2) Whether Navy shore facilities meet applicable environmental standards.

(3) What federal, state, and local environmental standards apply to a Navy shore facility.

(4) What current and anticipated air and water pollution deficiencies need corrective action.

F. Engineering Field Division (NAVFAC-EFD)

It is the duty of NAVFAC-EFD to determine:

(1) What air, liquid, and solid waste are discharged from Naval shore activities.

(2) Whether these discharges violate federal, state, or local rules, regulations and/or standards, or those standards contained in Navy directives.

G. Chief of Naval Material

It is the duty of the Chief of Naval Material to:

(1) Identify the effect on the environment of Naval activities and operations.

(2) Provide information on pollution monitoring systems.

(3) Determine what the applicable federal, state, or local regulations are for a hazardous material.

(4) Ascertain what are the hazards to man and the environment for a hazardous material.

H. Chief of Naval Training

It is the duty of the Chief of Naval Training to decide what training programs are needed to train personnel to handle monitoring, measuring, and abatement programs.

I. Major Claimants

It is the duty of major claimants to determine:

(1) What aspects of a specific operation significantly affect the environment.

(2) Whether abatement of a pollutant is adequate, whether it provides compliance with applicable regulations, and whether the operators are competent.

J. Area Coordinators

It is the duty of Area Coordinators to:

(1) Determine what aspects of a specific operation significantly affect the environment.

(2) See that abatement of a pollutant is adequate, that it provides compliance with applicable regulations, and that the operators are competent.

(3) Determine what pollutants are being emitted by a specific facility or operation.

(4) Provide information on cost and effectiveness of different aspects and equipment for cleaning up oil spills.

K. Naval Base Commanders/Commanding Officers

It is the duty of Naval Base Commanders/Commanding Officers to determine:

(1) What aspects of a specific operation significantly affect the environment.

(2) That abatement of a pollutant is adequate, that it provides compliance with applicable regulations, and that operators are competent.

(3) What noise hazardous areas are found within a facility.

(4) What noise hazardous areas can be expected in a new or planned facility.

(5) What methods to attenuate noise from a facility have been successfully adopted elsewhere.

(6) What pollutants are emitted by on-going programs, existing facilities, or proposed new actions.

(7) What the effect is on the environment of continuing and proposed actions, programs, and facilities.

L. Naval Electronic Systems Command

It is the duty of the Naval Electronic Systems Command to decide what current methods are available for pollution measuring, control, and abatement.

M. Shore Installations

It is the duty of all shore installations to fulfill all applicable federal, state, or local standards, guidelines, and broad requirements.

N. System Commanders, Project Managers, and the Director, Laboratory Program

It is the duty of all System Commanders, Project Managers, and the Director, Laboratory Programs, to:

(1) Determine whether a continuing or proposed new action or program will have a significant adverse impact on the environment.

(2) Ascertain what the impact is of a continuing or proposed new action or program on air quality, water quality, sound control, and land use.

(3) Provide the following information on the local area where the action is to take place:

- Demographic factors
- Government organizations
- Geography, topography, and geology
- Climate, hydrology, and oceanography
- Land and water use
- Area biosystems of interest
- Pollutants.

(4) Determine what pollutants are being emitted by a specific facility or operation.

O. NAVAIR Groups

It is the duty of NAVAIR Groups to decide what pollutants are being emitted by a specific facility or operation.

IV USERS

On the basis of the analysis of the above directives, the following users of environmental data have been identified:

Council on Environmental Quality

Secretary of the Navy

DoD

Assistant Secretary of Defense (Health and Environment)

Assistant Secretary of Defense (Installations and Logistics)

Director of Defense Research and Engineering

Secretaries of the military departments and the Directors of Defense Agencies

Department of Defense Environmental Pollution Control Committee

Bureau of Medicine and Surgery

Naval Supply Systems Command

Naval Air Systems Command

Commandant of the Marine Corps

Office of Naval Research

Environmental Pollution Control Program

Deputy Chief of Naval Operations (logistics)

Office of the Chief of Naval Operations

Chief of Naval Material

Area coordinators

Commanding officers

Commander NAVSUP

Commander NAVFAC (NEPOB under NAVFAC)

Commander NAVSHIPS

Commander NAVAIR

Commander NAVELEX

Commander NAVORD

Shore installations

Deputy Commander for Nuclear Propulsion.

Appendix B

AN ENVIRONMENTAL EFFECTS FRAMEWORK
FOR THE NEPDB

Appendix B

AN ENVIRONMENTAL EFFECTS FRAMEWORK FOR THE NEPDB

I OBJECTIVE

The objective of structuring an environmental effects framework (EEF) for the NEPDB is to provide in the conceptual design a basis for system development to respond to user requirements that may not now be apparent. User requirements derived from a list of existing questions may require expansion and periodic updating for several reasons:

- The existing list of user questions represents a perceived understanding of authorities and responsibilities imposed by vague and generally worded directives and guidelines on the various Naval organizational elements.
- Environmental protection authorities and responsibilities within the Navy are currently in a state of flux and are subject to redefinition and change.
- Goals, objectives, criteria, and standards for achieving desired levels of environmental quality are continually changing.
- Technical means for achieving desired levels of environmental quality are continually being improved.

II APPROACH

The NEPDB user requirements are related to responsibilities and authorities for environmental quality management. Therefore, the approach taken to develop user requirements through the structuring of an EEF can be described as follows:

- Structuring the interrelationship between Naval operations and activities, the resultant environmental effects, and their social consequences.
- Showing how possible intervention by environmental quality management actions can propagate through the cause-effect relationships developed above to achieve a desired environmental quality goal.
- Specifying the complete range of data required to characterize the environmental effects--environmental quality management interactions.

It is recognized that in any specific situation the scope of available environmental quality management actions may be relatively limited. In fact, at any point in time most of the user requirements can be satisfied by a given range of management actions. Accordingly, the EEF can provide a means for specifying a phased growth of the NEPDB encompassing an increasingly greater range of environmental effects and environmental quality management actions.

It is further recognized that, although a specific management action is more or less directly linked to a desired effect, the indirect and higher order effects will become apparent through the EEF cause-effect relationships. Thus, the EEF can provide a basis for structuring an environmental effects predictive capability within the NEPDB.

III THE GENERATION OF ENVIRONMENTAL EFFECTS

The EEF is developed by tracking material through the processes by which it is ultimately disposed in the environment and interacts with other uses of the environment. A simplified and generalized scheme for this is shown in Figure B-1. The main segments of the EEF have been designated as:

- Production-consumption
- Waste discharge
- Environmental quality
- Biological effects
- Socioeconomic impacts.

A. Production-Consumption

The production-consumption cycle converts input factors into useful output and unwanted residuals. The formulation makes a distinction among raw materials, consumable supplies, and the facilities by which they are used in processing, production, and operations. The production-consumption cycle for a naval facility may be characterized by the following series of sequential stages:

- Design and planning
- Production

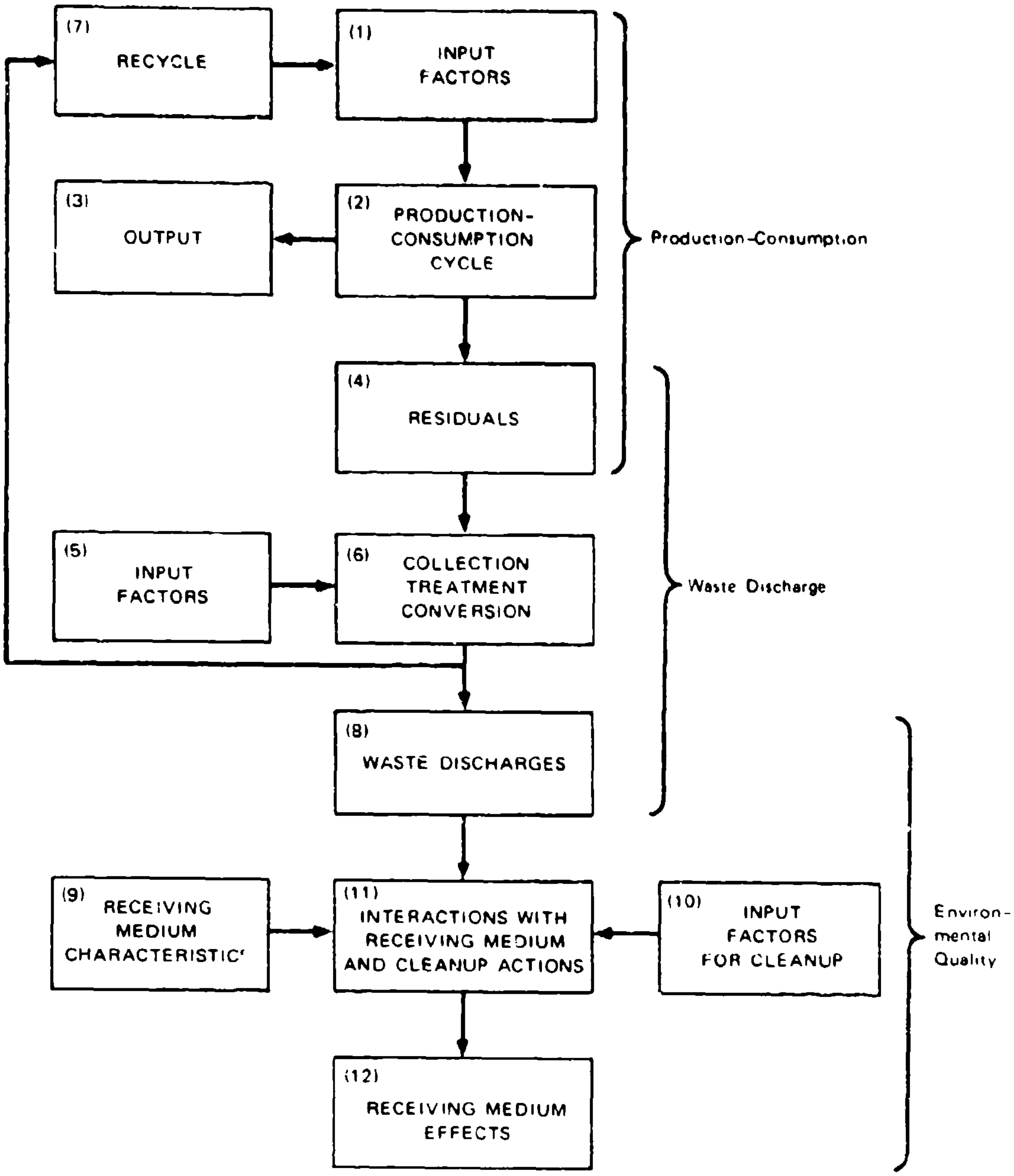


FIGURE B-1 ENVIRONMENTAL EFFECTS FRAMEWORK

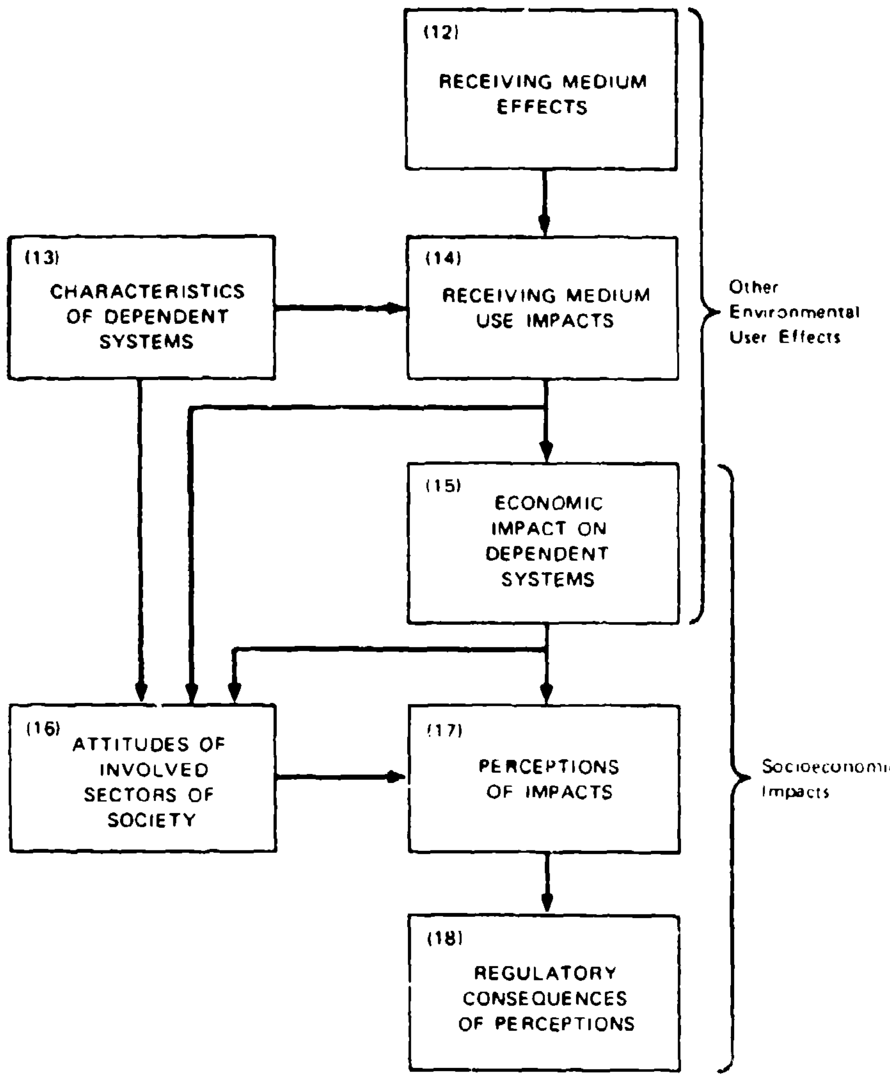


FIGURE B-1 ENVIRONMENTAL EFFECTS FRAMEWORK (Concluded)

- Distribution
- Consumption
- Retirement.

At each of these stages in the life cycle of a naval facility, residuals may be generated. The basic concept is that of an energy-material balance. This may be set up on the basis of the steady state operation of a naval facility or complex of facilities. It may be based on a unit of output or input factors at a particular state in the production-consumption cycle. It may be the cumulative residuals generated on the basis of a facility or class of facility carried through all or part of the production-consumption cycle. The important point is that varying the dimensions of the system on which the energy-material balance is to be struck determines the type of NEPDB user question that may be addressed. Another important point is that the energy-material balance concept is a powerful tool for accounting for all residuals.

B. <u>Waste Discharge</u>

The residuals generated by the production-consumption cycle are candidates for recovery as valuable scrap or for disposal as unwanted wastes. This segment of the EEF is concerned with the latter category of residuals. Within limits the residuals may be collected, treated, or transformed by facilities so that they may be disposed in a more acceptable manner. For example, sewage is transformed into gas that may be burned and sludge that may be disposed on land or burned in an incinerator; sound may be converted

to heat; waste heat may be disposed to water bodies or directly transferred to the atmosphere; certain gases may be dissolved in solutions and disposed as a liquid or precipitated for disposal as a solid; and airborne particulate matter may be collected as a solid. The important point is that residuals are not destroyed; they are merely disposed in another form or in a different media.

The processing of residuals by facilities is analagous to the production-consumption cycle; thus, the comments made above under that category hold equally well in this segment of the EEF.

C. Environmental Quality

The media--air, water, and land--into or onto which wastes are discharged have a finite capacity for diluting, dispersing, attenuating, assimilating, or holding wastes. When the aggregate waste discharges in a region exceed this capacity, then the environmental quality of the region suffers. The geographic limits of the region that can be affected by waste discharges at specific locations are determined by complex characteristics of the receiving media and will not correspond for the different media. The extent to which the environmental quality characteristics of a receiving medium can be affected by waste discharges in terms of both space and time provides further dimensions for addressing user questions to the NEPDB.

Waste materials will interact with the receiving media and will be transformed or removed at rates that are characteristic of the waste material and the available waste handling or assimilative capacity of each receiving medium. In addition, under certain conditions the contaminated receiving medium can be treated or processed to remove certain materials and thereby improve the environmental quality.

D. Biological Effects

The receiving media for wastes comprise the living environment for biological systems. A change in the physical or chemical characteristics of the receiving media can therefore affect the life processes of these dependent biological systems. These effects can be directly on an organism itself or can be felt indirectly through the ecological interrelationships of the various species.

The human organism differs from other species in its response to environmental quality in at least two important aspects. Humans can process environmental components to an acceptable level of quality, e.g., drinking water; but humans look to the environment for more than life support needs. Humans use the environment as a resource to support a desired life style or standard of living. These uses have both environmental quality requirements and environmental quality effects. Therefore, when a change in environmental quality occurs because of some perturbation in the usage structure in a region, some uses are made more or less desirable. Benefits

are transferred to those sectors of society whose uses are made more desirable or whose increased usage is responsible for the change in environmental quality. On the other hand, other sectors of society find that they must bear an additional burden of cost to process an environmental component to an acceptable level of quality to that they may maintain their desired level of use, or they must reduce their usage.

The shifts in usage patterns that accompany a change in the physical and chemical characteristics of the receiving media cause conflicts among the users of the environmental components. These conflicts result in stresses and disruptions in the social organizations through which humans interact.

The organization of biological organisms that are affected by a change in the environmental quality characteristics of a receiving medium presents a further dimension to which NEPDB user questions may be directed. Some categories for organization include biological classification according to: organism types, a hierarchical ordering, environmental component dependency, ecological interrelationships, and social organization and economic interaction.

E. Socioeconomic Impacts

The social consequences of the impact on biological systems resulting from changes in the environmental quality characteristics of the receiving media depend on the perception of these impacts by groups whose

interests are believed to be affected. These perceptions, in turn, are influenced by the attitudes of these interest groups toward the changes that are perceived and the activities that are believed to be responsible for these changes.

The social consequences that may take place may take many forms. If there are no credible institutionalized mechanisms for addressing the perceived impacts, then these consequences may become disruptive. The basic dimensions for addressing questions to the NEPDB about these social consequences are through a categorization of affected social interest groups.

IV THE CONTROL OF ENVIRONMENTAL EFFECTS

A. Approaches to Environmental Quality Problems

The ultimate objective of environmental quality management is solving social problems that arise from changes in environmental quality characteristics. There are four different approaches that can be taken when attempting to solve a social problem: systemic, preventative, ameliorative, and compensatory. The alternative strategies can be illustrated by four types of solutions to the problem of mercury poisoning resulting from humans eating contaminated seafood. A systemic solution would be to provide alternative foods in the diet. A preventative solution would be to stop mercury discharges to the aquatic environment. An ameliorative solution would be to provide care and therapy for the victims. A compensatory solution would be to pay the victims or their survivors for the damages suffered.

The emphasis in the United States by the environmental control regulatory authorities is on the preventative approach to solutions. Since the social problems arise at the end of a long chain of dependent effects as shown by the EEF, there are many opportunities for intervening at various points in the cause-effect chain to affect the dependent effects.

Few feedback loops exist in the EEF, and thus there is little opportunity to influence prior causes.

B. Environmental Quality Control Modes

The preventative approach to environmental control can be applied in three modes: predictive, interactive, and remedial. The predictive mode relies on there being sufficient knowledge of the cause-effect relationships expressed in the EEF to select appropriate control techniques so that the unwanted effect cannot occur. This is best applied at the planning phase of an operation or the design phase of a facility. The purpose of the Environmental Impact Statement required by the National Environmental Policy Act of 1969, P.L. 91-190, for all federally funded or regulated facilities is to inject environmental considerations into the planning process.

The interactive control mode operates in real time so that an indication of a situation is sufficient reason to expect an undesirable dependent effect. This allows for the possibility of intervening in the cause-effect relationship between the indicator signal and the dependent effect to limit the dependent effect to the extent desired. This control mode also requires a knowledge of the cause-effect relationships, but this knowledge may be adaptive and ad hoc; in other words, it may be largely empirical, obtained through monitoring the control response in a particular situation.

The remedial control mode in essence learns from past mistakes. It is an after-the-fact application of control to prevent similar undesirable situations in the future. If the knowledge about cause-effect relationships so obtained is properly structured into an EEF-oriented NEPDB and augmented with special studies to fill gaps or to verify relationships, such a control mode can help build an environmental effects predictive capability. This approach to environmental control uses the environment as a working laboratory.

C. Control of Environmental Effects

In practice, an effective environmental quality management program will use all four types of solutions available in all appropriate modes, as required by the specific set of circumstances. The ideal is, of course, the preventative solution in a predictive mode, but this may not always be possible or even desirable in terms of the practical constraints established by real situations. An idea of the possible kinds of control actions in the cause-effect relationships represented by the EEF that may be exercised to influence dependent effects is illustrated in Table B-1. Some of these actions may not appear to apply directly to Naval activities, but when it is considered that Naval activities are supported directly or indirectly by a wide range of civilian activity, the connection becomes more apparent. For example, a user tax on leaded motor fuel has been often suggested as a means of promoting the use of low lead or lead-free

Table B-1

CONTROL ACTIONS RELATED TO ENVIRONMENTAL EFFECTS

Input factors

- Control the use of specific materials
  - Prohibition of specific materials
  - Rationing
    - Price means (user tax)
    - Nonprice means
      - Use permits
      - Licensing of users
  - Specification of composition
    - Licensing of producers
    - Licensing of materials

Production and consumption

- Control of production output or extent of operations
  - Quantity--licensing of production or operation
  - Quality--product composition or performance specifications
- Control of processes or operations
  - Technology
    - Licensing of facilities, processes, or operators
    - Standards and specifications for design and operation
  - Time and location
    - Land-use control
    - Licensing or permits for each specific instance
    - Restriction to specific seasonal, diurnal, or other temporal characteristics

Residuals

- Control on amounts--specification related to process or operation
- Control on characteristics--physical properties, chemical composition, or biological characteristic related to process or operation

Treatment or conversion

- Specification of Requirements--degree of treatment, types of processes or level of technology in terms of residuals
- Control of processes or operations
  - Technology
    - Licensing of facilities, processes, and operators
    - Standards and specifications for design and operation

Table B-1 (Continued)

- Institutional arrangements
  - Specification of administrative control
  - Specification of pooling, regionalization, joint use, or use of municipal or commercial facilities
- Time and location
  - Land-use control
  - Licensing or permits for each specific instance
  - Restriction to specific seasonal, diurnal, or other temporal characteristics

Waste discharges

- Control of disposal media--specification of discharge mode
- Control of discharge characteristics
  - Properties--specification of physical properties, chemical composition, or biological characteristics
  - Amounts
    - Discharge permits
    - Prohibition of specific materials
    - Specification of mass emission rates, absolutely or relative to some operational or receiving medium property
    - Discharge tax
  - Time and location
    - Land-use control
    - Licensing or permits for each specific instance
    - Restriction to specific seasonal, diurnal, or other temporal characteristics

Interactions with receiving medium and cleanup actions

- Apportionment of receiving medium "capacity"
  - Prior appropriation
  - Administrative rationing
  - Use charge rationing
- Specification of cleanup action--cleanup contingency planning

Receiving medium effects

- Specification of air, water, land "quality" standards
  - Physical properties
  - Chemical characteristics
  - Bioassay characteristics

Table B-1 (Concluded)

Receiving medium use impact
Control of uses
Limitation of uses
Use charges
Use permits
Prohibition by administrative means
Prohibition by physical means to limit access
Promotion of uses
Subsidies for users
Facilities to promote uses
Declaration of beneficial uses
Internalizing "externalities"
Biological systems impact
Specification of air, water, land "equality" standards in terms of biological characteristics
Declaration of beneficial uses
Perceptions of impacts
Specification of public relations programs
Specification of educational programs
Specification of information exchange programs
Social consequences of perceptions
Administrative compensation program for "damages"
Contingency plans for dealing with social problems
Institutionalizing the resolution of social concerns

gasoline. Although such a tax would not apply to Naval purchases, it would certainly apply to the civilian employees who use their automobiles to commute to their jobs on a Navy base. To the extent that the Navy base commuters witch to low lead motor fuel, car pools, or public transportation, the emissions will be reduced and the air quality will be improved.

D. Environmental Quality Management

Several functions must be accomplished to establish an environmental quality management program:

(1) Adopting goals, objectives, criteria, guidelines.

(2) Specifying appropriate environmental effects management actions to achieve function (1).

(3) Specifying monitoring, evaluation, and reporting program to support function (2).

(4) Organizing authorities and responsibilities for the environmental quality management program.

(5) Allocating resources to the various elements to support their authorities and responsibilities.

The NEPDB is directly related to function (3), whereas function (3) is specified to support function (2). Functions (4) and (5) are necessary for the entire program. Table B-1 shows the range of possible environmental effect control actions that may be applied at the various stages of the EEF to affect the outcome of dependent effects. The data needs to support this range of possible environmental control actions are shown in Table B-2.

Table B-2

ENVIRONMENTAL DATA NEEDS TO SUPPORT CONTROL ACTION

Input factor data

- Use rates, duration and time, location
- Physical properties, chemical composition, biological properties, public health and handling characteristics, shelf life, perishability or other chemical and physical transformations
- Purchase specifications, unit cost, responsibility for purchasing

Production-consumption cycle

- Production rates, conversion rates of input factors, operational speed, duration and time, location
- Characterization by unit process or operation, equipment specifications, operator qualifications
- Capital costs, depreciated and replacement value, operating and maintenance costs, training costs of operators, times to implement
- Purchase, operational, and maintenance specifications and responsibilities

Residuals

- Generation rates, duration and time, location
- Physical properties, chemical composition, biological properties

Treatment or conversion

- Throughput rates of residuals and input factors
- Production rates of outputs, conversion rates of input factors and residuals
- Other data as under production-consumption cycle, above

Waste discharge

- Discharge rates, duration and time, location, source, responsibility
- Physical properties, chemical composition, biological properties, public health and handling characteristics, degree of reactivity with various receiving media, degree of physical transformation in various receiving media

Table B-2 (Continued)

Receiving medium characteristics

Characterization of the natural processes that define dilution, dispersion, attenuation, assimilation, or holding capacity for waste discharges in general

Air--meteorology, diffusion, insolation, photochemistry, sound transmission

Water--hydrology: watershed, ground water, rivers, estuaries, coastal zones, oceans

Ground--geology, soils, and seismic properties

Baseline quality characteristics--physical, chemical, and biological

Interactions with receiving medium and cleanup actions

Characterization of natural processes and remedial cleanup processes by which the baseline quality characteristics are changed by specific waste discharges

Receiving medium effects

Changed baseline quality characteristics--physical, chemical, and biological

Characteristics of dependent biological systems

Characterization of populations, distributions, and ecological interrelationships with respect to receiving medium effects

Nonhuman (plants and animals; aquatic and nonaquatic)

Characterization of effect of environmental quality on life cycle needs (primarily feeding and metabolic processes, and reproduction)

Human

Characterization of effect of environmental quality on life cycle needs (physiological), life style desires (psychological), and on industrial processes

Characterization of social and economic organizations by interests related to receiving medium use

Receiving medium use impact

Characterization of the changes in the use quality of the environment for the dependent biological systems resulting from receiving medium effects

Table B-2 (Concluded)

Impact on biological systems

- Characterization of the "well-being" of communities of dependent organisms resulting from changes in use of the receiving medium imposed by changes in the quality
  - Nonhuman
    - Biomass production rate
      - Total
      - By species (especially "indicator" species)
    - Species diversity index
  - Human
    - Health effects (physiological, psychological)
    - Social effects
    - Economic effects

Attitudes of involved sectors of society

- Characterization of society in terms of relevant interests
- Characterization of relevant interest groups in terms of attitudes toward:
  - Environmental quality
  - Impacts resulting from changes in environmental quality
  - Activities of the Navy

Perceptions of impacts

- Characterization of beliefs of interest groups concerning the impacts of changes in environmental quality on their interests

Social consequences of perceptions

- Characterization of actions taken by interest groups to ameliorate the perceived impacts of changes in environmental quality on their interests

In practice, an environmental quality management program is limited to a specific set of control measures that are designated as "standards" by the responsible regulatory agencies. The most commonly applied standards limit the amount of a particular waste discharge to a receiving medium. Even though the objective is the control of ambient receiving medium quality, this has certain practical conveniences:

- The responsibility of a waste discharge can be readily identified. However, once a material has been dispersed in a receiving medium, it can no longer be tracked unambiguously to its source.
- The concentration of a pollutant in an emission from an exhaust stack or outfall pipe is high enough to be analyzed accurately, whereas the concentration in a receiving medium may be below the sensitivity of analytical techniques.
- The instantaneous and integrated rates of discharge can be determined.

These conveniences dictate this type of standard even though in many cases the relationship of such standards to the environmental quality characteristics of the receiving medium is tenuous at best. The formulation of rational and equitable waste discharge standards would be greatly enhanced by the development of a predictive capability based on the cause-effect relationships expressed in the EEF.

A waste discharge standard must ultimately be expressed in terms of a monitoring sampling, and analysis program. For example, although the standard may read that the concentration of mercury in a waste discharge stream may not exceed 5 ppm, what is really implied is that the samples of the stream (which are of a certain size and are taken at a certain

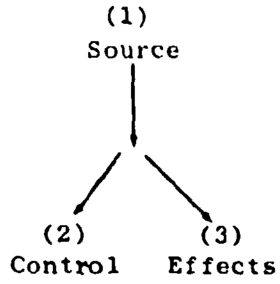
frequency and are handled and then analyzed according to certain methods) shall not exceed the desired concentration limit. The same comments apply to any type of standard--waste discharge, receiving media, biological effects, or social consequences. The data, representing a sample of the universe, will have characteristics related to:

- Accuracy (how well do the results represent reality?).
- Range of validity (to what geographic, volumetric or mass, or population limits does it relate?).
- Perishability (for what period of time is it valid?).

E. NEPDB User Requirements

On the basis of the concept of an environmental quality management program described above, an environmental protection data base that describes and supports such a program for the Navy would contain several categories of information. The categorization of such information would most usefully be based on a structuring of user requirements in the form of user questions since this represents a basis for the design of a cost-effective NEPDB.

The basic user question relates a source of emissions to the environmental effects as they are influenced by the control actions applied. The relationship of these three question elements is shown by a simple diagram:



These three elements are part of any basic questions whether they are explicitly stated or only implied. In any specific question something unique must be stated or assumed about the source (1) and then either the control (2) or the effects (3) are determined as a function of the other. The question may, of course, have any tense and it may be asked directly or in an inverted form. There is another category of question that can be asked of the NEPDB that might be classified as secondary or indirect, as opposed to the basic questions. Secondary questions are questions about the NEPDB and its functioning; they cannot be derived from an environmental quality management program concept but instead must arise from the organization of the NEPDB within the Navy. This present discussion, therefore, addresses the basic user question.

The basic user question may deal with the full range of environmental effects, as shown in Figure B-1, or only with a portion of the cause-effects relationships. Therefore, any user question can be characterized as to the range of environmental effects considered. The effects generation segment [Source (1)--Effects (3)] will correspond to a pair of

numbered boxes on Figure B-1, for example Box 2 to Box 12. This segment will be characterized by the corresponding data shown in the above diagram. The control application segment of the question [Source (1)--Control (2)] will begin at the same box in Figure B-1 as the effects generation segment, but will terminate at the box representing the point in the EEF where the control procedure is applied, for example Box 8. Thus the control action will be described by one of those listed in Table B-1 corresponding to Box 8 in the EEF. This procedure generally characterizes the user questions. However, a specific question will have some dimensions applied to the three question elements. A possible range of dimensions of the question elements is shown in Table B-3.

The dimensions that can be applied to the waste discharge generating system depend primarily on the manner in which a system is defined for an input factor-waste discharge energy and material balance. Therefore, the listing under the Source (1) question component in Table B-3 is a hierarchical ordering that begins with the smallest unit of naval equipment that generates residuals in its functioning, and considers how these basic units might be assembled in increasingly larger functional combinations. These various functional units and assemblies might also be considered according to some element of commonality. The elements of commonality are varied, but the major ones relate to the waste materials discharged, the equipment type and condition, the functions or operations performed, the geographic location, and the status in the

Table B-3

DIMENSIONS OF ELEMENTS OF BASIC USER QUESTION

Source (1)

- Degree of assembly of equipment units
  - Residual generator or waste discharge processing equipment unit
  - Functional assemblies of equipment units
  - Complexes of functional assemblies
- Groupings of assemblies of equipment units
  - Materials discharged
    - Input factors
    - Residuals
    - Waste discharges
  - Equipment type and condition
  - Functions performed or operations conducted
  - Geographic location
  - Status in production--consumption cycle

Control (2)

- Degree of specificity of control action
  - Basis for control action
  - Methodology of control actions
  - Monitoring control actions
  - Control action reports
- Mode of control action
  - Predictive
  - Interactive
  - Remedial
- Problem solving approach
  - Systemic
  - Preventative
  - Ameliorative
  - Compensatory

Effects (3)

- Level of dependency of affected system
  - Receiving media
  - Biological systems
  - Socioeconomic systems

Table B-3 (Concluded)

- Effects measurement characterization
  - Accuracy
    - Sampling technology
    - Analysis technology
    - Operator qualification
  - Range of validity
    - Sample size
    - Sample distribution
  - Perishability
    - Sample frequency
    - Sampling duration
    - Turnaround time from sample to report
- Effects data treatment
  - Point measurement
  - Baseline averages
  - Historical trends
  - Projections and extrapolations
  - Summations and integrations

Common dimensions (1), (2), and (3)

- Authorities and responsibilities
  - Naval organization
  - Political jurisdiction
- Resources involved
  - Human
  - Economic

production-consumption cycle. There are other elements of commonality that apply to all three user question elements, and these are discussed separately below.

The dimensions for the Control (2) element of the basic user question shown in Table B-3 relate primarily to an ordering of the degree of specificity of the control action. Thus, the dimensions listed in the table proceed from the most general type of objective and goal to more specific standards, and thence to the operational interpretation of these standards in terms of measurements and reports. Other possible elements of commonality are the characterization of the control action according to the mode (predictive, interactive, remedial) and its problem-solving approach (systemic, preventative, ameliorative, and compensatory).

The Effects (3) element of the basic user question can be dimensioned according to the level of dependency of the systems affected. These are the systems through which the effects caused by the source as it is controlled propagate through interaction, dependency, and feedback linkages. The basic ordering of systems dependency proceeds from effects generated in the receiving media (air, water, land) to the impacts on the biological systems that rely on the receiving media for life support and beneficial uses, and thence to the impacts on the human socioeconomic systems resulting from changed patterns of use of an environmental component.

These effects are described by data that represent measurements of samples of the affected systems. Therefore, other possible elements of commonality are represented by the characterization and treatment of the data in terms of the relationship of the sample to its universe.

Two areas of commonality apply to all three of the basic user question elements: the authorities and responsibilities involved and the resources involved. The authorities and responsibilities can be organized according to some structuring of the Naval and political organizations and jurisdictions; these are basically hierarchical in nature but there are areas of overlap and mutliple responsibilities in both categories. The resources involved can be characterized as human and economic. This is the area of commonality that provides dimensions of costs and benefits to the user question.

Appendix C

THE LEGAL INFORMATION BASE

Appendix C

THE LEGAL INFORMATION BASE

I INTRODUCTION

A major component of the Navy Environmental Protection Data Base (NEPDB) will be the information files concerned with the laws and regulations that pertain to environmental quality control and the legal ramifications of these laws and regulations on the operations of private and public organizations and facilities. Such legal material arises from a number of sources. Legislation at the federal, state, and local levels provides the primary material of interest. These laws, in turn, provide the legal authority for the promulgation of rules and regulations by the executive level of government and an assortment of administrative agencies concerned with environmental quality. These administrative rules and regulations, which normally have the same effect of law as the statutes from which they evolved, provide the basic operational guidance to organizations affected by environmental quality laws.

A third source of legal information, and perhaps the most important, is the set of court decisions and administrative agency rulings that provide the substantive interpretation of laws, rules, and regulations.

Unfortunately, there is no single repository for this legal material as it is generated. Moreover, the methods of filing, the indexing of the files, and the completeness of the files are dependent on the level at which the material is generated and the type of organization in which it is generated. Thus, to provide for inclusion of this type of information in the NEPDB information system design, it is necessary to understand both the origins of their laws and regulations that arise and the source from which these materials can be obtained.

It is the purpose of this appendix to discuss some of the basic legal materials, the forms in which they appear, and the sources of the material.

II THE NATURE OF LEGAL MATERIAL

A. Legislation

1. Forms of Legislation

At both the federal and state levels, laws and regulations derive from legislation that can be classified into two categories: conventional legislation and subordinate legislation. Conventional legislation comprises the output of legislatures, constitutions, interstate compacts, and, at the federal level, treaties. Subordinate legislation, which is generally authorized by conventional legislation and in effect delegates authority to promulgate rules and regulations, comprises the rules and regulations of administrative agencies, orders and proclamations of the executive officer, and the rules of courts. Municipal ordinances are regarded as conventional legislation in some states and as subordinate legislation in others.

2. Conventional Legislation

a. The Federal System

By judicial interpretation only three types of conventional federal legislation are designated as "laws". These are the act, the joint congressional resolution, and the treaty.

1) The Act

Acts are the most common form of congressional legislation. On initial introduction into one of the houses of Congress, they are referred to as bills and are given a designation based on the house of introduction, e.g., HR4264 (House of Representatives) and S.42 (U.S. Senate). When passed by the originating house, they are referred to as "Acts" on introduction into the other house. When passed by both houses and signed by the President or when both houses overrule a Presidential veto, acts become Acts of Congress and part of the body of Public Laws of the United States. At the time of such passage they are given a public law designation, e.g., P.L. 86-102, where the first digits refer to the number of the Congress (86th), and the second digits refer to the bill number in that Congress (102nd).

2) The Joint Resolution

The joint resolution is a resolution approved by both houses of Congress that has the same effect of law as an act. Joint resolutions normally are submitted to the President and require his signature; however, certain of these resolutions such as those proposing constitutional amendments, do not require the President's signature. Joint resolutions become part of the public laws.

3) Interstate Compacts

Interstate compacts arise in the states concerned. Congress is required to give its consent to such compacts and accomplishes this through an act or a joint resolution or by approving a state constitution embodying the compact. Interstate compacts, once approved by the Congress, become part of the body of public laws of the United States; they also become part of the session laws of the individual states.

4) Treaties and Executive Agreements

A treaty is an international compact entered into by the President with the approval of the Senate. An "executive agreement" is an international compact entered into by the President that does not require Senate approval. A formal treaty has the force of a federal statute, becomes part of the law of the land, and is binding on state and local communities. It may even supercede prior acts of Congress. Executive agreements may be upheld as the law of the land; however, they normally will not supercede an act of Congress.

5) Other Conventional Federal Legislation

Other forms of conventional legislation that arise but that do not have the force of law include the simple and the concurrent congressional resolution. The simple resolution has effect only on the house in which it originates. The concurrent resolution is binding on both houses after it has been approved by both houses.

b. The State System

States, in general, follow the legislative pattern of the federal system. Of significance to the environmental quality problem are the state constitutions, constitutional amendments, state legislature session laws, and municipal charters and ordinances. In contrast to the federal system, joint legislative resolutions may or may not have the force of law, depending on the state. In all states, legislative session laws are included in the body of public laws; that may be called Acts and Resolves, Public Laws, Acts, or Joint Resolutions. These titles generally refer to the enactments of state legislatures at regular and special sessions of the legislature.

3. Subordinate Legislation

The subordinate legislation at both the federal and the state level consists of the rules and regulations made by the President, state Governors, administrative agencies, and the courts. These rules and regulations derive from either constitutional perogatives of the individual concerned or from the delegation of authority by enabling legislation passed by the legislatures and approved by the executive. In general, these administrative laws govern the day-by-day transactions that occur within and between government and the individual private citizen and/or organization. Therefore, they can be more significant than some of the statutory legislation that gave them origin.

a. The Federal System

1) The President

The President has a wide rule-making authority, much of which he delegates to individual executive agencies under his control. Some of the forms of Presidential rules are:

- Treaties and Executive Agreements. These have been discussed above.
- Reorganization Plans. Reorganization plans are executive orders that become law unless disapproved by either of the houses of Congress. They are normally concerned with the creation, modification, and/or abolition of executive agencies below the rank of department.
- Proclamations and Executive Orders. Proclamations and executive orders are devices used by the President to accomplish many of his functions. They include orders ranging from the appointment of minor Civil Service rules to the establishment of administrative agencies during periods of national emergency, such as the Office of Price Administration during World War II. Much of this authority is delegated to the President by Congress through specific legislation.

Other bases for this authority are contained within the constitution.

2) <u>Administrative Agencies</u>

Administrative agencies outside the Executive Department are created by Acts of Congress and are normally fixed with the responsibilities for the control and overseeing of activities in specific areas of federal jurisdiction. Included among the agencies that have relevance to the environmental quality problem are the: Interstate Commerce Commission, Federal Trade Commission, Food and Drug Administration, Federal Aviation Administration, Atomic Energy Commission, and Environmental Protection Agency.

b. <u>The State System</u>

Much of the business of state and local governments is conducted through the vehicle of administrative rules and regulations. However, the promulgation of state rules has been handled in a much less satisfactory manner at the state and local levels than at the federal level. Most states licensing and regulatory agencies and commissions compile and distribute their rules and regulations, as do Tax Equalization Boards, and Workman's Compensation hearing officers. However, the practice is not uniform, and in some instances some difficulty can be encountered in locating such material. The possible sources will be discussed in a later section.

B. Court and Administrative Agency Decisions

Although the laws, rules, and regulations enacted and promulgated by executive officers, legislatures, and administrative agencies comprise the guidance within which the elements of government systems operate, the essential and substantive content of these laws, rules, and regulations are contained in the opinions rendered by the courts and administrative hearing officers. In general, both federal and state court decisions of record refer primarily to those cases that have reach some appellate jurisdiction, although there are some cases of record for the lower federal courts. In contrast, the rulings and decisions of federal administrative agencies are not necessarily recorded in a form that makes them easily available. The custom of the specific agency will determine the extent and availability of such decisions. State administrative agency rulings generally follow the pattern of federal agency rulings. Here, also, there can be some difficulty in finding official reports for all but a few organizations.

III LEGAL INFORMATION SOURCES

A. The Federal System

1. Laws and Joint Resolution

Acts and joint resolutions of Congress are officially published first as "slip laws", which generally become available from the United States Government Printing Office about three weeks after date of approval. In this form the law is identified by the law number (PL designation) and the Congress and bill number (Congress Number and H.R. or S. designation). About 14 months after the slip law publication, a bound volume of the official "Statutes at Large" containing the law will be issued. At this point in time, the law can be identified by a volume and page number, i.e., 78 STAT. 172 (Volume 78, p. 172). It should be noted that at the time the slip law is published, the Statutes at Large designation will be shown next to the title on the first page of the law. From a legal research standpoint, the proper citation of the law is the Statute at Large designation.

Although the Statutes at Large are the best evidence of the law, there are a number of problems in using these volumes.

First, the laws in them are published in chronological order by approval date. Second, the Statutes at Large contain "public" and "private" acts and acts having only local interest, and the result is a somewhat cumbersome collection of material. Third, many of the acts are soon repealed, amended or expire because of some date or event limitation. As a result, the Statutes at Large do not necessarily reflect the best collection of laws presently in force.

To make the problem of locating in-force law easier to deal with, many of the public laws are republished with other laws on the same subject or in the same area, with amended portions included and repealed or expired portions omitted, in an official codified compilation called the "United States Code (U.S.C.)." It is important to note that not all of the Statutes at Large are so codified; however, the Statutes omitted are generally of only limited interest. New editions of the U.S.C. are issued at approximately 6-year intervals.

The U.S.C. is divided in 50 titles, corresponding to Agriculture, Patents, Transportation, and so on. The citation for a U.S.C. entry is given by title number, section and edition date, e.g., 42 U.S.C. 4395 (1964). Titles of significance to the problem of environmental quality control include, among others: Title 3 - Executive Orders; Title 5 - Reorganization Plans; Title 33 - Water Pollution; and Title 42 - Environmental Pollution.

2. Treaties and Executive Agreements

Statements about international acts of the United States first appear in the "Department of State Bulletin". Subsequent publication of these acts are in a slip-law form, which is listed in the "Monthly Catalog of Government Publications". Compilations of the international acts are then published in "Treaties and Other International Act Series", which is cited as T.I.A.S. This series has been in existence since 1945. Before 1945, treaties and executive aggreements were compiled in two separate series: the "Treaties Series" and the "Executive Agreement Series".

3. Subordinate Legislation

Federal administrative legislation (which includes Presidential proclamations and executive orders and other documents that the President orders to be published; all documents issued under proper authority that prescribe penalties and courses of conduct and confer rights, privileges, and authority, impose obligations, or are relevant or applicable to the general public, members of a class, or persons of a specific locality; documents or classes of documents required to be published by acts of Congress; and other documents deemed to be of sufficient interest by the Director of the Federal Register) is published in the "Federal Register". This publication, which is published daily, Tuesday through Saturday except on days following a legal

holiday, is the repository of the literal texts of all documents officially promulgated under the law. It is part of the Federal Register System, which is comprised of the Federal Register, the Code of Federal Regulations, the Weekly Compilation of Presidential Documents, the Government Organization Manual, and the Public Papers of the President of the United States.

Like the Statutes at Large, the Federal Register is a chronological compilation of documents characterized by some of the same limitations as the Statutes. Accordingly, at the end of each calender year the rules and regulations then in force are republished in the "Code of Federal Regulations (C.F.R.)." In addition, some of the rules in force are also published in the U.S.C., and most administrative agencies publish their own rules in separate pamphlets. However, these pamphlets are often somewhat out of date.

Like the U.S.C., the C.F.R. is organized into 50 separate titles, the first five of which are concerned with the organization of the government. Remaining titles, in part, correspond to those of the U.S.C.; however, the internal organization is somewhat different. A citation of a C.F.R. item is by title and part, e.g., 8 C.F.R. 235.12, where the right hand numerals refer to subsection 12 of part 235. Title 42, Parts 151 through 153, and Parts 456 through 481 are concerned with some of the more critical aspects of environmental quality control.

B. The State System

1. Laws

Every state publishes its legislative sessions laws, normally in a single volume. Resolutions, which in some states lack the force of law, are usually contained in the same volume after the acts. Although some states publish these volumes in a classified arrangement, most states follow the federal system of chronological order. The name of this publication varies with the state, and titles such as Acts and Resolves, Public Laws, Acts and Resolutions, and so on are used. Few states publish official slip laws, although in an increasing number of states unofficial session-law services publish annotated "advance sheets" of the latest enactments.

As in the federal system, states usually have statutary compilations, many of which follow the pattern of the U.S.C. They may be called Codes, Revisions, Compilations, Consolidation, General Statutes, or Statutes, depending on the preference of the legislature. In some states uncodified (uncompiled) laws may be published in a separate volume. An example is McKinneys "New York Unconsolidated Laws".

The method of organization of these compilations varies, although most use a subject-title method, e.g., California Civil Code, California Health and Safety Code, California Code of Civil Procedure, and so on.

2. <u>Subordinate Legislation</u>

The publication of state administrative rules and regulations is not completely satisfactory. Most state agencies concerned with licensing and regulation publish their regulations separately. In a similar fashion, Tax and Equalization Boards, Workman's Compensation hearing officers, and the like are also likely to publish their regulations. Only 14 states now publish any form of compiled regulations similar to C.F.R.

IV COURT AND ADMINISTRATIVE AGENCY DECISIONS

A. Court Decisions

1. General

As has been stated earlier, the substantive content of the law is contained in the set of court decisions concerning the law. The difficulty, however, is that only those cases that have reached some appellate jurisdiction are reported in court report compilations. Moreover, some courts do not report in any type of official publication, and interested parties must resort to "unofficial" reporter systems.

2. The Federal System

a. The U.S. Supreme Court

All written opinions of the Supreme Court are reported in the official "United States Reports," which is a bound volume of the decisions of the Court. During a term of the Court, slip decisions, which are separate decisions in pamphlet form, are issued each Monday. The slip decision contains only the text of the opinions, which may be corrected at a later date. Also during the term, advance sheets (called "Preliminary Prints") are published separately for individual decisions. These advance sheets are, in general, identical to the printed decision as it will appear in the bound volume of the United States Reports. It is generally published from a month to six weeks after the decision is handed down.

b. Lower Federal Courts

Most lower appeals courts publish slip decisions. However, there are no official reporters for most of these courts, and unofficial systems must be used. Courts still publishing official reports are Court of Claims, Court of Customs and Patent Appeals, and other administrative tribunals.

3. The State System

Most states publish official reports; however, the trend is toward discontinuing such publications. As of 1969, approximately 10 states had discontinued official publication. In these states, resort must be made to the unofficial reporter series for that state or region.

B. Administrative Agency Decisions

There is no consistency with respect to the issuance and compilation of written opinions of administrative agencies. Where they exist, they are generally similar in form to the decisions of the courts.

1. The Federal System

Administrative agency decisions may appear in any or all of the following forms:

- Press releases. Usually mimeographed, press releases appear within a day or two of the decision. They are usually in abridged form and are circulated to newspapers and other interested parties.

- Mimeographed reports. These reports also follow the decision by one or two days and may contain abridged or complete decisions. They normally have some form of serial designation by which they can be cited.

- Printed slip decisions. Although uncommon, printed slip decisions resemble court slip decisions in format, designation, and style.

- Advance sheet pamphlets and bulletins. The content and frequency of advance sheet pamphlets and bulletins vary with agency. Some contain botn agency and court decisions, other agency decisions and rules of practice, dockets, and so on.

- Bound Volumes of Agency Rulings. These volumes are similar to bound Court reports.

2. The State System

State administrative agency decisions follow the pattern of the federal system; however, official publication of them is rare except for opinions of the Attorney Generals, which are combined in a monthly "Digest of Opinions of Attorneys General," published by the Council of State Governments, and annual utility commission decisions, which are published in "Public Utilities Reports."

C. Unofficial Reporter Systems

As a result of the inadequacies, omissions, and time delays in the preparation of official court and agency reports, there has grown up in the United States a series of unofficial reporter systems that produce bound and compiled decisions, together with annotations to specific points of law. One of the most widely used systems is the "National Reporter System," published by the West Publishing Company, St. Paul, Minnesota. Its tremendous utility lies not only in its currency and detail, but in the fact that all parts of a decision in a particular case are referred by a set of "Key Numbers" to digests of applicable

law. With this system and the indexes that are available, it is possible to find all pertinent case law on any specific subject that is current to the date of the digest-supplement publication, usually within a few weeks of the search date.

Other unofficial series are also available. However, these are normally of less scope than West's series and do not provide the simplicity of use.

1. <u>The "National Reporter System" (West)</u>

The "National Reporter System" consists of a set of volumes reporting court decisions from all appellate jurisdictions of the United States. At present, the following volumes are available:

- "Supreme Court Reporter." This series reports in full every decision of the Supreme Court of the United States, beginning with the October term of 1882.

- "Federal Reporter." This series contains the full decision of the U. S. Circuit Courts from 1880 to 1912, the District Courts of the United States from 1880 to 1932, the U.S. Court of Claims from 1929 to 1932 and since 1960, the U. S. Court of Appeals from 1891, the U. S. Court of Customs and Patent Appeals from 1929, and the U. S. Emergency Court of Appeals from 1943.

- "Federal Supplement." This series connects with Volume 60 of the "Federal Reporter," 2nd Series. It reports decisions from the U. S. Court of Claims from 1932 to 1960, U. S. District Courts since 1932, and U. S. Customs Court since 1956.

- "Federal Rules Decisions." This series reports in full opinions of the U. S. District Courts that are not designated for publication in the Federal Supplement and that involve Federal Rules of Civil Procedure (since 1939) and Federal Rules of Criminal Procedure (sice 1946).

- "Regional Reporters." These volumes contain opinions of state and local courts. The set consists of:

  - "Atlantic Reporter" (Connecticut, Maine, Maryland, New Hampshire, New Jersey, Pennsylvania, Vermont)
  - "North Eastern Reporter" (Illinois, Indiana, New York, Ohio)
  - "North Western Reporter" (Iowa, Michigan, Minnesota, Nebraska, North Dakota, South Dakota, Wisconsin)
  - "Pacific Reporter" (Alaska, Arizona, California, Colorado, Idaho, Kansas, Montana, Nevada, New Mexico, Oklahoma, Oregon, Utah, Washington, Wyoming)
  - "South Eastern Reporter" (Georgia, North Carolina, South Carolina, Virginia, West Virginia)
  - "Southern Reporter" (Alabama, Florida, Louisiana, Mississippi)
  - "South Western Reporter" (Arkansas, Kentucky, Missouri, Tennessee, Texas)
  - "New York Supplement" (all decisions of New York Court of Appeals since 1887 and all opinions of Appellate Division of the Supreme Court.
  - "The California Reporter" (all decisions of the California Supreme Court, the California District Court of Appeals, and the Appellate Department of the California Supreme Court since 1960).

2. <u>The "Key Number Digest System" (West)</u>

In each reported decision in the "National Reporter System," paragraphs, headnotes, and other material will carry "Key Note" indexes. These key numbers are references to a series called the "West Digest System," consisting of digest volumes for each state and the District of Columbia, except Nevada, North Dakota, and South Dakota; volumes for each of the "Regional Reporters;" and the "Supreme Court Digest," the "Federal Digest," "Modern Federal Practices Digest," and the "U. S. Court of Claims

Digest." In addition, all digest volumes are keyed to the "American Digest Volumes," which have published 7 decennial digests covering the period from 1897 through 1956, and a "General Digest Series" covering the period since 1956.

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13. ABSTRACT

This concept definition of the Navy Environmental Protection Data Base (NEPDB) system analyzes the user requirements for environmental data and develops characterizations of data base components. Preliminary concepts for data base organization and indexing are discussed extensively, and a number of required data files are identified. The functions that the system must perform are discussed and shown in flowcharts and more detailed signal flow diagrams.

Major alternative system operations discussed are: centralized/decentralized operations, manual/automatic operations, and index and storage media. Trade-off analyses of these alternatives are made and evaluated according to specific criteria. The results of these evaluations are then used to synthesize a set of final NEPDB system options. These options are discussed and the preferred option is recommended. Assumptions made during the course of this study are listed and recommended for further study. A phasing of the growth of the NEPDB system is discussed with subsequent recommendations.

Finally, a plan for the NEPDB Phase II effort is developed, estimates of initial system implementation costs are given, and manpower costs for initial system operation are provided.

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